Staphylinus hesperus, n. sp.

S. *ater, æneſcens, pube fusca sat dense vestitus; capite crebre punctato; thorace creberrime subtiliter æqualiter punctato, subtiliter marginato; scutello dense piceo tomentoso; elytris thorace dimidio brevioribus, crebre sat fortiter rugulosis; abdomine sat crebre punctato, segmentis* 2^{o}–4^{m} *macula aureo tomentosa basali; pedibus piceis, geniculis tarsisque rufescentibus, tibiis anticis aureo ciliatis; antennis piceis, articulo ultimo rufo. L.* 6–7 *lin.*

Hab. Sub lapidibus prope Angram in ins. Terceira sat copiose lectus.

EXPLANATION OF PLATE XXIII.

Fig. 1. *Tarphius wollastoni*, n. sp., p. 386.
2. *Heterodercs azoricus*, Tarn., p. 375.
3. *Agabus godmanni*, n. sp., p. 385.
4. *Acalles drouetii*, n. sp., p. 387.
5. *Attalus miniatocollis*, Tarn., p. 387.
6. *Laparocerus azoricus*, Drouet, p. 388.
7. *Neocnemis occidentalis*, n. sp., p. 389.
8. *Elastrus dolosus*, n. sp., p. 386.
9. *Asynonychus godmanni*, n. sp., p. 389.

April 11, 1867.

Dr. J. E. Gray, F.R.S., V.P., in the Chair.

Mr. P. L. Sclater stated that the living Lyre-bird (*Menura superba*) alluded to by Dr. Bennett in his communication to the Society on this subject in March last year* had safely arrived in this country a few days since in the ship 'La Hogue,' under the care of Mr. Ross, its proprietor, by whom it had been deposited in the Society's Gardens. From the statements in Dr. Bennett's letter it would appear that this bird was now about two years and seven months old†.

Mr. Sclater also reported the birth in the Society's Menagerie on the 17th ult. of a young male Giraffe, being the *sixteenth* that had been bred in the Society's Gardens. The event was of more than usual importance, as the fire of the 6th of November last, and the subsequent death of the adult male (aged 21 years) on the 22nd of January, had reduced the Society's stock to a single female. Mr. Sclater laid before the Meeting the following list of the Giraffes that

---

* See P. Z. S. 1866, p. 167.

† This bird has since been purchased for the Society's collection.—P. L. S.

had been living in the Society's Gardens since the first acquisition of these animals:—

List of Giraffes which have lived in the Zoological Society's Gardens.

No.	Sex.	How acquired.	Date.	How disposed of.	Date.
1	Female	Imported	May 24, 1836	Died	Oct. 15, 1852
2	Male	Imported	May 24, 1836	Died	Oct. 29, 1846
3	Male	Imported	May 24, 1836	Died	Jan. 14, 1849
4	Male	Imported	May 24, 1836	Died	Jan. 6, 1837
5	Male	Born	June 19, 1839	Died	June 28, 1839
6	Male	Born	May 24, 1841	Presented to Dublin Zoological Soc.	June 14, 1844
7	Male	Born	Feb. 25, 1844	Died	Dec. 30, 1853
8	Male	Born	Apr. 22, 1846	Died	Jan. 22, 1867
9	Male	Born	Feb. 12, 1849	Sold	Apr. , 1850
10	Female	Imported	June 29, 1849	Died	Nov. 3, 1856
11	Female	Imported	June 29, 1849	Sold	Oct. , 1853
12	Male	Born	Mar. 30, 1852	Sold	Mar. , 1853
13	Female	Born	Apr. 25, 1853	Living in the Gardens	
14	Female	Born	May 7, 1855	Destroyed by fire	Nov. 6, 1866
15	Female	Born	July 16, 1859	Died	Dec. 2, 1859
16	Female	Born	May 20, 1861	Sold	May , 1863
17	Male	Born	Oct. 7, 1861	Died	Dec. 18, 1861
18	Male	Born	May 8, 1863	Sold	Nov. , 1863
19	Male	Born	Sept. 24, 1863	Died	Apr. 21, 1864
20	Male	Born	Mar. 31, 1865	Died	Apr. 3, 1865
21	Female	Born	Apr. 20, 1865	Sold	May 31, 1866
22	Male	Born	Sept. 14, 1866	Destroyed by fire	Nov. 6, 1866
23	Male	Born	Mar. 17, 1867	Living in the Gardens	

The following papers were read:—

1. Note on the Nidification of *Baza subcristata*.

By E. P. Ramsay, C.M.Z.S.

During my recent trip to the North Richmond River, *via* Grafton, I met with this rare species upon several occasions. I found it giving preference to the edges of the scrubs on the Richmond and Clarence Rivers, whence it would sally out to the more open parts in the mornings and evenings in search of food, and not unfrequently visit the slaughtering-establishments in the vicinity of the townships.

In plumage the sexes are alike; but the male may be distinguished by the occipital crest being more developed. I have two females, one procured on the Clarence and the other on the Richmond River, both of which have a slight wash of rufous round the ear-coverts and on the sides of the neck,—and one male, which, having the centre of the abdomen and under tail-coverts chestnut, has the bands on the breast and flanks slate-brown; whereas in other individuals these bands are of a chestnut hue. Others, again, have the throat, underside of the neck, and chest slate-grey, with the rump and upper tail-coverts of a bluish slate-grey. The irides in both sexes are of a beautiful deep yellow.

I was fortunate enough to procure three eggs of this species, taken by Mr. MacGillivray's black fellow "Daddy." Mr. MacGillivray informs me that, when Daddy was taking the eggs, the female dashed so close to him that he killed it with his tomahawk. The male bird belonging to the nest had been shot the day before. The nest was a comparatively small structure of sticks placed upon a horizontal bough, at a considerable distance from the ground. It contained three eggs, much smaller than I expected to find them. They have the peculiarity of being very much rounded at the larger end, are short upon the whole, and have the thin end pointed abruptly. Their average length is $1\frac{7}{10}$ inch by $1\frac{4}{10}$ inch in breadth; the ground-colour greenish white (the inside of the shell being of a pale steel-green), very sparingly smeared and blotched or spotted with light brown; one specimen has but two or three spots of a light brownish tint.

I know of no districts frequented by so many species of the Hawk-tribe as the brushes and flats in the neighbourhood of the Richmond and Clarence Rivers. During the first fifteen days of our sojourn in those parts we met with no less than fifteen species, well identified, besides one or two others, the species of which I was not quite sure of. Seven of these were skinned; others, being very common in the neighbourhood, were allowed to remain in peace. The following is the list of Hawks met with during our journey from the mouth of the Clarence River, *via* Grafton, to Lismore on the Richmond River:—

Aquila audax. Plentiful.
Polioäetus leucogaster. Several pairs seen.
Haliastur sphenurus. Shot.
—— *leucosternus*. Only one seen.
Falco lunulatus. Shot.
Hieracidea berigora. Shot.
Leucospiza novæ-hollandiæ. Shot (iris blood-red).
Astur radiatus. Shot (iris bright yellow).
—— *approximans*. Shot.
Accipiter torquatus. Shot.
Milvus affinis. Several seen.
Elanus axillaris. Shot (iris blood-red).
Baza subcristata. Shot (iris bright yellow).
Circus jardinii. Shot.
—— *assimilis*. Two specimens seen.

To these may be added *Milvus isurus, Falco melanogenys*, and *Gypoictinia melanosternon*, all of which, I believe, were procured by Mr. MacGillivray in the Clarence River district. Of *Astur radiatus* I only obtained one specimen, a male; it seems to be a very rare species, and one which I had never before met with. Total length 23 inches. This specimen lost its life by coming too near our camp in pursuit of some Parrakeets (*Trichoglossus multicolor*), which it was endeavouring to catch; its flight is remarkably strong and rapid. A pair of *Falco lunulatus* and a female of *Accipiter torquatus* committed the same rash act, and paid the penalty with their lives.

Haliastur leucosternus was one of the first birds that greeted us as we entered the Clarence River, and, after flying round the steamer once or twice, ascended the river before us. A fine specimen of this species was shot by Mr. MacGillivray on the Clarence River during 1865.

2. Notes on certain species of Cats in the Collection of the British Museum. By Dr. John Edward Gray, F.R.S., V.P.Z.S., F.L.S., &c.

(Plates XXIV. & XXV.)

Having to name some of the Cats recently received, it was requisite to compare them with those already in the collection; and I herewith send some observations that I made on them when so occupied.

The Leopard and the Serval of Africa are too well known to require any observation, except to remark that the Serval is by no means so variable in the form and disposition of the spots as the Leopard.

There is a series of Cats from the West Coast of Africa that are very little known; and, fortunately, there are in the British Museum the type specimens on which three of the species have been founded, and of two of them other and better specimens of the skins than those first described have been received and are in the collection, showing the distinctness of the species, which were each described from a single imperfect skin.

The three very distinct species of Spotted Cats from West Africa, which have been described at different times by Mr. Waterhouse, Mr. Ogilby, and myself, all differ from the one from Guinea described by M. Temminck. My *Felis neglecta* agrees with *F. celidogaster* in many particulars; but the spots are much smaller than M. Temminck describes, they are by no means of a chocolate or bright brown colour, and the tail is not ringed. These are just the characters by which the three skins in the British Museum are distinguished from each other. It is most probable that the *F. celidogaster* of Guinea is distinct from the Cats from the Gambia and Sierra Leone which are in the Museum. All the three, and, indeed, very many other Spotted Cats, have the belly distinctly spotted and the throat with a half collar; so that the name *F. celidogaster* would be equally applicable to any of them.

The three species in the Museum may be distinguished thus:—

1. **Felis neglecta**, Gray, P. Z. S. 1860, p. 246; Mag. N. H. 1838, p. 27.

Grey; head and body marked with numerous small darker spots,

spots of the lower part of the sides rather larger; belly white, with large blackish spots; tail quite half the length of the body, with a dark line along the upper surface, sides paler, with obscure indications of darker bands.

Hab. Gambia (*Rendal*). The typical skin in British Museum.

2. Felis servalina, Ogilby, P. Z. S. 1839, p. 4.

Fur fulvous, beneath white, middle of the back darker, with very numerous small black spots, spots on sides rather larger, on the belly much larger; tail short, fulvous, with five or six imperfect black rings and a pale tip.

Hab. Sierra Leone. Three skins in British Museum.

3. Felis rutila, Waterhouse, P. Z. S. 1842, p. 130.

Red-brown, with indistinct darker spots on the back; belly white, with large brown spots; tail moderate, nearly half the length of the body, red-brown, with a dark central line down the upper surface, paler with obscure indications of bands on the sides.

Hab. Sierra Leone. Type and two other specimens in British Museum.

The skull of this species is in the British Museum. It is oblong; the orbit rather large, incomplete behind; the intermaxillary produced and extending halfway up the side of the nasal; the upper front false grinder very small.

Temminck has described a Cat purchased at the sale of Bullock's Museum in Piccadilly under the name of *Felis celidogaster* (Monogr. Mamm. 140), stating that he believes that it inhabits Chili or Peru (more lately it has been believed that it might be an Indian Cat—the *Felis viverrina* of Bennett, for example); but no Cat of the kind is known in those countries. In his 'Esquisses' he has redescribed the species from a specimen received from Guinea. The following is a translation of his description:—

"Felis celidogaster, Temm. Monogr. i. 140; Esquisses Zool. 87.

"*Felis chalybeata*, H. Smith, Griffith, A. K. ii. t. (not good).

"Tail rather shorter than half the length of the body and head. Length of body and head 26, tail 14 inches = 3 feet 4 inches.

"Fur short, smooth, shiny, grey, with a reddish tint, with chocolate or light brown spots; spots on dorsal line oblong, the others round; cheek and lips whitish, with small brown spots; throat and chest with six or seven half-circular brown bands; lower parts and inner side of the limbs pure white, with large round chocolate-brown spots; two bands of this colour on the inner side of the fore, and four on the hind feet; tail bay brown, with paler brown rings, end black brown; outer face of the ears black; claws white."

Lesson, in the 'Magasin de Zoologie' for 1839 (Mammifères, t. 10), has figured and described a Cat under the name of *Felis senegalensis*, which is said to have been brought from the river Senegal. It is thus described:—"*Felis* rufo- fulvoque-griseus, subtus rufescentialbidus, auriculis latis intus albidis, supra nigerrimis cum lunula nivea; dorso et lateribus tribus vittis nigris nec non lineis formatis numerosissimis maculis atris; cauda longa, rufescenti-grisea, nigro maculata; facie rufa, duabus lineis et naso aterrimis; rostro albo; pedibus rufo-griseo punctatis." The description and the figure do not agree with any of the three Cats from Africa in the British Museum.

The *Felis neglecta*, like the Serval, has no dark streak on the cheek, which is so generally found in Cats. In Lesson's figure only one throat-streak (the upper one in most other Cats) is marked, the second streak mentioned in the description being from the side of the forehead to the end of the nose. The tail in Lesson's figure is longer in proportion to the body than the tail of the Serval, or of any of the three African Cats here described; and the belly is not white, as it is in all of them and in *F. celidogaster* of Temminck. In some respects the Cat agrees with *Felis viverrina* of Bennett from India (can there be any mistake in the African habitat?); but the streaks on the side of the face are different from those of that Cat, which has two in the usual situation; indeed the streak in Lesson's figure is so unlike the streak in any Cat that I have seen that I almost doubt whether the artist has correctly represented it as going from the orbit to the middle of the front edge of the ear.

GUEPARDA GUTTATA, jr. (Pl. XXV.)

The young Hunting Leopard (*Gueparda guttata*) I do not recollect to have seen described. It is covered with long soft hair, of a dark blackish brown colour, on the limbs, sides, and beneath, and very obscurely spotted; the head, back of the neck, the back, and the upper surface of the tail are pale brown; back of ears black; an angular line from the front of the orbit to the angle of the mouth dark brown; the lips, chin, and sides of the nose white.

Hab. Cape of Good Hope.

There are two Cats in the British Museum (one from India and the other from Africa) which are peculiar for having the body marked with transverse or, rather, perpendicular bands which are more or less broken into spots; and they have more marked, wider, and black bands across the upper part of the fore and hind legs. The tail, which is not quite so long as the body, is of the same colour as the back, and has some narrow black rings near the tip, which is black.

The grey species comes from India. There is a single specimen of it in the British Museum, which in the 'List of Mammalia,' published in 1842, I named the Waved Cat (*Leopardus inconspicuus*), p. 42, referring it to the *Felis torquata* (*Chat de Nepaul*, F. Cuvier, Mamm. Lithogr. ii. t.) with doubt, because the tail of that species is represented as of the same colour as the back, with a series of triangular spots forming half bands on the lower surface for the whole length, and there is only one streak (the upper one) on the cheek, while our specimen, like almost all the species of Cats, has two well-marked streaks. As no specimen like the figure has been received from India, I am now inclined to believe that it is intended to represent the Cat in the Museum, and that the differences are perhaps the errors of the artist. Indeed it is doubtful if the figure is not a copy of an Indian drawing, like several of the animals figured in that work, said to have been received from M. Duvaucel. I cannot agree with Mr. Blyth in thinking that *F. torquata* is the same as *F. ornata*.

Mr. Hodgson sent from Nepaul a very large specimen, which agrees with the typical specimen of *F. inconspicuua* in its most essential characters, but is much larger, and the waved bands are more broken into spots; these spots are all nearly of the same form. The head and body of the stuffed specimen is 25 inches, and the tail 11 inches long. In the list of Mr. Hodgson's specimens he asks "is it a Tame Cat?" p. 6. Mr. Hodgson, in his MS. list, called it *Felis viverriceps*. There is a third, smaller specimen in the British Museum, received through Capt. Boys from India.

The second, which varies from pale fulvous to grey, is the *Felis maniculata* of Rüppell (Zool. Atlas, t. 1), from various parts of Africa. There are several specimens of this species in the British Museum. The largest and darkest, being grey with darker bands, is a specimen from Tangiers, received from M. Verreaux, the body and head 24, and the tail 14 inches long; the darker bands are very indistinct. There is a second example, not quite so large, with bands darker, that lived several years in the Zoological Gardens, and was sent from Tunis by Sir Thomas Reade—and a smaller one, similar in colour, also from the Zoological Gardens, but without any special habitat attached, and a dark grey kitten from Kordofan.

Two other specimens are pale yellowish, slightly grizzled, with the streak and spot of the body rather darker yellow, and the rings on the end of the tail are black. One of these, brought from Macassar by Mr. Wallace, is rather darker than the other, and has the bands on the legs nearly black, like the Tunisian specimen. The other, from Kordofan, is rather paler, and the bands on the legs, like those on the body, are yellow.

Very nearly allied to these, and probably only a variety, is a small nearly white Cat, marked with pale yellow stripes, sent from Egypt by Mr. Christie, which I described in the 'Magazine of Natural History' for 1837 under the name of *Felis pulchella*. It differs greatly from all the other specimens of *F. maniculata* in the very large size of the ears; but it resembles them so closely that I am almost inclined to believe that it may be only a very pale variety of that species. The size of the ears may have been produced by the negligence of the stuffer; but that can only be decided by the examination of fresh specimens. Mr. Blyth thinks that this specimen is only "an Egyptian variety of the Common Cat" (P. Z. S. 1863, p. 184, note); but I cannot agree with that theory.

The three large specimens in the British Museum of these Cats come from South Africa. The largest was received from M. Verreaux, the next largest from the Zoological Society's Museum under the name of *Felis caffra* (*Felis nigripes* of Burchell), the other from Dr. Andrew Smith as *Felis caffra*.

The first two of these are dark grey, with distinct dark, blackish bands and spots. Dr. Smith's specimen is much paler, yellow, with very indistinct rather darker yellow bands and spots, and very broad black bands on the legs.

The large specimens from Tunis and Tangiers are very like the largest dark one from the Cape.

A rather small specimen, received from Mr. Brandt of Hamburg as *F. caligata* from Africa, is only obscurely banded, is peculiar in the tail being black at the tip for about an inch, and in only having three or four very obscure narrow cross bands across the upper surface of the hinder two-thirds of the length of the tail.

A small specimen, very obscurely banded and having a redder fur with darker red streaks on the back, was received from Capt. Speke, marked "Menessá."

The *Felis caligata* of Africa and the *F. inconspicua* of India are nearly allied and very similar; but one is grey and the other more fulvous and rather differently marked—so much so that I think they are distinct. They and *Felis indica*, the "Domestic Cat of India," differ from *Felis chaus* of India (and Africa?) in the greater length of the tail. The first two are almost always more or less distinctly banded and spotted, the *F. chaus* and *F. indica* being very obscurely (if at all) banded, except on the legs and thighs.

I suspect that what have been called the African *F. chaus* may be only pale varieties of *F. caligata*; at least I have not seen any specimens of the true *F. chaus* from Africa. M. F. Cuvier's figures of *F. chaus* from Egypt are doubtful; for he describes the body and head as being 2 feet 4 inches long, and the tail 9 inches long; but the figure represents the tail as two-fifths, while the description represents it as being only one-fourth of the entire length. In the same manner the *Chat aux oreilles rouges*, figured by M. F. Cuvier, Mamm. Lithogr., from a specimen from India, is said to measure 24 inches from the end of the nose to the base of the tail, and its tail to measure 10 inches; and in the figure the tail is very nearly half the length of the head and body. Can both or either of these figures represent *F. chaus*, which is known by its short tail?

I believe that all these African Cats are of one species, varying greatly in size and colour. The synonymy will be as follows:—

Lynx, Bruce, Voy. viii. no. 30.
"*Felis caligata*, Bruce," Temm. Monogr. p. 123.
? *F. lybicus*, Olivier, Voy. p. 41.
F. caffra, Desm. Suppl. p. 540, 1822.
F. nigripes, Burchell, Travels, 1822.
F. maniculata, Rüppell, Zool. Atlas, i. t. 19 (pale variety).
?? *Chat aux Oreilles Rouges* ou *Chat botte* (*F. caligata*), F. Cuvier, Mamm. Lithogr. t. (pale variety).
F. pulchella, Gray, Mag. N. H. (very pale variety).
F. chaus, Rüppell, Atlas, i. t. 140.
? *Chaus*, F. Cuvier, Mamm. Lithogr. t.
F. obscura, Desm. Mamm. p. 250 (black variety).
The "*Chat noir du Cap,*" F. Cuvier, Mamm. Lithogr., and *F.*

caligata, β, Fischer, Synopsis, p. 208 (from F. Cuvier's figure), is only a melanism.

The largest Cape specimen measures, body and head 30, tail 15 inches.

Most of the specimens of *Felis caligata* from Africa, like *Felis domestica*, *F. indica*, and *F. torquata* and many other species, have the hinder part of the feet black; but this is not a permanent character; for some of the smaller paler specimens of *F. caligata* have the hind feet paler than the back of the animal, and some of these have the heels more or less brown or blackish on the outer edges.

In the British Museum there is a specimen of *Felis domestica* that was collected, by Mr. Darwin, wild in the woods at Maldanado, mentioned in the 'Voyage of the Beagle,' Mam. p. 20. It shows how nearly the Domestic Cat is to the above species: it chiefly differs from *F. caligata* in the tail being more slender and tapering, the colours more intense and defined, and in the throat being pure white. It is dark grey, grizzled with black streaks and spots; the streaks on the legs are wide, those of the fore legs more or less confluent. The tail is grey for two-thirds of its length, with black rings, the hinder one being broadest; the hinder third of the tail is black, with a small pure-white tip. The stripes on the loins are straight and parallel, not subspiral as in the Tabby Cats. The cheek-streaks are black, the lower one indistinct and interrupted. The toes are white.

The smaller Spotted Cats of the warmer parts of Asia have all been regarded as one species by Mr. Blyth, following in the wake of Temminck; but it is to be observed that the latter naturalist only had the specimens from Java and Sumatra to examine. Perhaps if he had had in his museum specimens from Nepal, Bhootan, China, and the various districts of continental India, he would not have regarded them as belonging to the same species, as he did those from Java and Sumatra. They, no doubt, are very similar, and we know that the Spotted Cats, as the Leopard, the Jaguar, the Ocelots, and the Kuichua, of Brazil are very variable; but then in a large series of these specimens the varieties pass into each other, and the countries where the different varieties come from are contiguous, and different varieties come from the same locality. Now that is not the case with the small Spotted Cats of India; and until we have a series sufficiently large to show how the species do pass into each other, I think it is safer to regard them as valid.

Some of the smaller-sized Spotted Asiatic Cats have a long head, with an elongated skull, and complete bony orbits. The skulls are longest and the orbits more developed in the *Felis viverrina* of Bennett and the *Felis planiceps* of Vigors and Horsfield. But, besides these, *Felis rubiginosa* of I. Geoffroy, in Bélanger's 'Voyage,' and the Cat which I described under the name of *Leopardus ellioti* in the 'Annals and Mag. of Nat. Hist.' for 1837 (x. p. 260) have a rather elongated skull and complete orbits, though Mr. Blyth regards *F. ellioti* as only a variety of his *F. bengalensis*.

Of the small-sized Spotted Asiatic Cats, which have an ovate skull and incomplete orbits, there are several specimens in the Museum which appear to be worthy of being noticed either as species or well-marked varieties. They all have two well-marked streaks on each cheek, and there is a pale or white streak up each side of the forehead, and one between the cheek-streaks.

To this group belong *Felis sumatrana* and *Felis javanensis* of Horsfield, Zool. Java; *Felis nepalensis*, Vigors and Horsfield, Zool. Jour. iv. t. 39; and *Felis chinensis*, Gray, Mag. N. H. 1837, from China. To these I wish to add the following:—

Felis pardinoides. B.M.

Fur grey brown, with large black grey-varied spots; chin and beneath white. Spots of vertebral line black; of withers large, oblong; of loins linear; of sides, shoulder, and rump large, roundish, varied with grey hairs in the centre, making them appear somewhat as if they were formed of a ring of smaller black spots; of thigh and fore legs black, small, and there confluent into cross bands. Tail with black rings. Length, body and head 19, tail 9 inches.

Hab. India (*Capt. Innes*; from Zool. Soc. Mus.).

Skull, length $3\frac{1}{12}$, width $2\frac{1}{12}$ inches; orbits moderate, oblong; hinder nasal opening oblong, with an angular front edge.

Felis wagati. The Wagati. B.M.

Fur fulvous; nose, chin, throat, and underside of body, and streak on forehead and cheek, pale yellow. Spots of body few, large, irregular-shaped; of withers large, elongate, broad; of loins elongate, narrow, more or less confluent. Tail with round spots.

Felis wagati, Elliot (*fide* Blyth).

Hab. India.

Differs from *F. pardochroa* and *F. sumatrana* in the large size of the spots.

Felis pardochroa. Nepal Tiger. B.M.

Fulvous, with various-sized and -formed black spots and streaks. Spots of the loins oblong, separate; throat, chin, and belly white, black-spotted. Tail irregularly and incompletely ringed.

Felis pardochrous, Hodgson, Calc. Journ. iv. p. 286; Horsfield, P. Z. S. 1856, p. 396.

F. nepalensis, Hodgson, icon ined.

Hab. Nepal (*Hodgson*).

Length, body and head 25, tail 12 inches. Skull, length 3 inches 11 lines, width 2 inches 8 lines.

Var. Fur shorter, closer. B.M.

Hab. Tenasserim (*Packman*).

Felis tenasserimensis. B.M.

Fulvous, black-spotted; chin and beneath white. Spots of the body large, angular; of shoulder round; of thigh oblong; of the loins elongate, confluent; of the back of the neck elongate, double at the hinder part, and on the withers nearly enclosing a lanceolate brown disk.

Hab. India; Tenasserim (*Packman*).

Like *F. pardochroa,* but larger; spots of withers and loins very different.

FELIS SERVALINA. B.M.

Fulvous, black-spotted; streak on forehead and cheeks, chin, throat, and beneath yellowish white. Spots small, unequal-sized, far apart; of body oblong; of legs round; of loins elongate, sometimes confluent; of withers oblong.

Chaus servalinus, Gray, Cat. Mamm. B. M. 45 (excl. syn.).

Hab. India; Zanzibar.

Like *F. sumatrana,* but spots smaller and further apart.

FELIS JERDONI.

Fur grey, with a few small distant black spots. Spots of sides and legs roundish; of central line of the back linear, rarely confluent. Tail and feet darker grey brown, scarcely spotted; chin and beneath white, black-spotted.

Felis jerdoni, Blyth, P. Z. S. 1863, p. 185 (not described).

Leopardus sumatranus (var. grey), Gray, Cat. Mamm. B. M. 43.

Hab. Indian peninsula: Madras. Adult in British Museum.

"Very like *F. bengalensis,* but smaller; the ground-colour of the upper part grey, untinged with fulvous" (Blyth). Size of *F. rubiginosa.* The "kitten" that Mr. Blyth refers to as being in the British Museum is a nearly full-grown specimen.

The following rather short-tailed Indian Cat has not been well understood. It has been most oddly mixed up by Mr. Blyth and others with *Felis torquata* (the *Chat de Nepaul* of F. Cuvier, Mamm. Lithog. ii. livr. 54), also named *Felis bengalensis* by Desmarest in the Supplement to his Mammalia, which is a grey-waved Cat, nearly like the English Domestic Cat, and is probably a half-bred Domestic Cat of India, as is said to be the case with the *F. nepalensis* of Vigors and Horsfield (Zool. Jour. iv. t. 39), which resembles this figure in some respects.

As the wild Indian species has not been characterized, I here describe the specimen in the Museum:—

FELIS ORNATA, Gray, Illustr. Ind. Zool. i. t. 2.

Fur short, pale whitish brown, black-spotted. Spots small; on the middle of the back smaller, linear; on the front part of the sides larger, oblong; on the hinder part of the sides small, round; on the thighs and upper part of the legs confluent, forming interrupted cross bands. Tail reaching rather below the heel, pale at the lower half, with some interrupted black rings at the end, which is whiter than the rest of the tail, the tip black. Crown with lines of small spots; cheeks with two narrow dark lines; chin, throat, and spot over the orbits whitish; belly with black spots, like those on the side. Body and head 19, tail 8 inches.

Hab. India (*Capt. Boys*).

This Cat is at once known from all the other Indian species by the length and slenderness of the tail, and the small size and equal distribution of the spots. In this respect it resembles the Hunting Leopard; but the band on the legs, the shortness of the tail, and the terminal half of the tail being ringed at once distinguishes it from that Cat and all the other species. The tail is somewhat like that of *F. chaus.*

Mr. Blyth has kindly given to the British Museum a specimen of the Domestic Cat of India, which is generally distributed there. It agrees with *Felis chaus* in almost every character, but it is smaller in size. The tail is rather longer compared with the length of the body, has more narrow black rings, occupying full half of the length of the tail, and there are two narrow pale cheek-streaks.

In the Museum there are two larger and rather darker specimens, agreeing in almost every particular with the above. They are most likely hybrids between *F. chaus* and *F. domestica.* The Wild *F. chaus* is peculiar for having the cheek-stripes very indistinctly marked, or one or both entirely wanting.

As regards South or Tropical American Cats, I may observe the skull of the Jaguar (*Felis onca,* Linn.) is known from the skulls of all the other species of the genus *Leopardus,* and from the Lion and the Tiger, by having a distinct, but more or less developed, tubercle (probably for the attachment of one of the muscles of the eyeball) on the middle of the inner or nasal edge of the orbit, and there is also a well-marked half ovate notch in the middle of the truncated front edge of the internal nostril, which is not so distinctly developed in other large feline animals.

The specimen which I described under the name of *Leopardus hernandesii* in the 'Proceedings' of this Society (1857, p. 278, Mamm. t. 58), from Mexico, has come into the British Museum collection; and I cannot find any difference in the skull to distinguish it from the other specimens of the Jaguar; so I suppose it must be considered one of the varieties of that species, marked by the distance at which the small spots are placed from each other, only now and then forming anything like a distinct ring or row of spots.

The Ocelots are extremely variable; and though there is a very large series of specimens in the British Museum, I cannot make up my mind whether they are all one, or whether there are three or more species. There are two most distinct varieties as regards size —the large Ocelots, with very large heads, and the smaller Ocelots, with more moderate-sized heads; but each variety presents several variations of colour, and there are examples intermediate in size. The differences in the size of the Ocelots may depend on the temperature, the geographical disposition, and the abundance or scarcity of food in the district which they inhabit. I can well believe that the large variety is as dangerous and destructive as the Jaguar, as travellers assert.

My *Leopardus pictus* (Mag. N. H. x. 260, 1842) is one of the larger kind, and it has the spots very different from those of any other specimen in the collection; but this is such a difference as one may expect to find only a variation when one examines a large series of specimens.

My *Leopardus griseus* (Mag. N. H. x. 260, 1842) differs from the other Ocelots in having a grey fur with whitish sides. There are several specimens which agree in this peculiarity. The grey specimens offer several variations in the spotting, like the fulvous specimens. One specimen has a rather yellow tint in the middle of the back; otherwise the grey colour seems permanent. Mr. Blyth has observed that the smaller and darker Spotted Cats become more fulvous as they attain full age; but that cannot explain the greyness of these specimens, as there are adult as well as young specimens of the grey colour.

Felis melanura (Ball, P. Z. S. 1844, p. 128) is a most strongly marked specimen, and in the whole series of specimens in the Museum stands alone for the intensity and clearness of the marking, both black, white, and fulvous. It may be a variety in which the colours, especially the black, are very much more developed than usual, and therefore the spots have become confluent, until the whole animal may be described as black with white and fulvous spots. It is not the common melanism, where the whole fur has become more or less black, the black spots being only a little more intense. We have an Ocelot of this latter variety in the British Museum; but it bears no resemblance to the type specimen described by Mr. Ball, which is also in the Museum collection.

In the British Museum there is a very small Spotted Ocelot, which may be recorded as a species or variety under the name of *F. pardoides*. The fur is grey, with a very large number of nearly equal-sized round or oblong dark spots; the spots on the loins and rump are larger, with a pale centre; the cheeks and nape with black streaks; belly white, with large black spots; tail ringed. Length of body and head 26, tail 13 inches. *Hab.* Tropical America.

The species or varieties are to a certain extent permanent; the young, in some instances at least, are like their parents; and the markings do not change with age (that is to say, they are the same on the kitten as on the adult); and there are adult specimens that are grey as well as fulvous, or fulvous and white; so that the grey colour does not depend on the youth of the specimen, as has been suggested.

Three species of small Spotted Cats have been described as inhabiting South and Tropical America. All these three species may be distinguished from the Ocelots (*Felis pardina*) by the smaller size of the head, and the spots not being united together in chains; but the latter character is not to be observed in all Ocelots. As these Cats, like the other Spotted Cats, vary greatly in the form, size, and disposition of the spots, the determination of the species has been attended with considerable difficulty, and it has been suggested that perhaps there are more than one species of the long-tailed American

Tiger Cat called *F. macroura*. There is a very large series of specimens of the long-tailed species in the British Museum (two Chatis and several Margays) from different localities. And if there were not so many offering such different variations of the first species in the collection (I had only a few selected specimens to describe from), I should have been inclined to separate them into more than one species; indeed, in 1842, when we had only four or five specimens, I did name one in the 'List of Mammalia' as a distinct species under the name of *Leopardus tigrinoides*.

These three species may be easily distinguished from each other by the kind and colour of the fur, and the colour and length of the tail. Thus *F. macroura* and *F. mitis* have soft bright fulvous fur, and tail distinctly ringed; and *F. tigrina* has a harsher grizzled fur, and the tail marked with series of dark spots, not forming distinct rings. They may be characterized thus:—

1. FELIS MACROURA, Pr. Max. Abbild. t. . The Kuichua.

F. wiedii, Schinz.
"*F. brasiliensis*, Cuvier."

Fur soft, bright fulvous, black-spotted; spots variable in shape and size, often with a pale centre; tail elongate, cylindrical, longer than the body, with from eight to ten broad, well-marked, often interrupted, black rings, and a black tip.

Var. Paler, spots larger.
Leopardus tigrinoides, Gray, List Mamm. B. M. 1842, p. 42.
Hab. Brazil.

2. FELIS MITIS, F. Cuvier, Mamm. Lithogr. t. . The Chati.

F. onca, Schreb. t. 102.
F. chati, H. Smith.

Fur soft, bright fulvous, black-spotted; spots variable in size and disposition, often with a pale centre; tail cylindrical, rather tapering at the end, nearly the length of the body without the head, with six well-marked, broad, sometimes interrupted black rings, and a black tip.
Hab. Mexico? Paraguay?

3. FELIS TIGRINA, Schreb. t. 106, from *Margay*, Buffon, H. N. xiii. t. 38. The Margay.

Fur rather harsh, dull, grizzled, varied with black spots and rings varying in size and form; tail moderate, nearly as long as the body, cylindrical, rather thick, truncated at the end, marked with small black spots often confluent but not forming continuous rings.
Hab. South America.

There is in the British Museum a Cat that was formerly alive in the Surrey Zoological Gardens, and was there called the Himalayan Cat, and which, in the 'List of Mammalia in the British Museum,' published in 1842, I called *Leopardus himalayanus*. This animal is figured, from the specimen at the Surrey Zoological Gardens, in Jardine's 'Naturalist's Library' as *Felis himalayanus*, Warwick. The figure is by no means a characteristic one. The Cat has not been brought from Himalaya by any of the numerous sportsmen and collectors that have searched that country. It is not known to Mr. Blyth, nor to any other Indian zoologist to whom I have shown it; indeed Mr. Blyth states that he believes it to be a South American Cat.

The examination of the skull shows that it forms a group by itself; and in my paper, read at the last Meeting but one, I formed for it a genus under the name of *Pardalina*. As the species has not been well described, I herewith add a description of the type specimen:—

PARDALINA WARWICKII. (Pl. XXV.) B.M.

Fur short, dusky whitish brown; chin, streak on cheek, and throat white; chest and underside paler, black-spotted; crown and nape with four, cheek with two, and between the withers one black streak; the four feet and body covered with very numerous, equidistant, nearly equal-sized small black spots; throat, chest, upper part of the inside and outside of fore and hind legs black-banded; tail spotted at the lower half, ringed at the end, with a black tip; ears black, with a large white spot.

Leopardus himalayanus, Gray, Cat. Mamm. B. M. p. 44.

"*Felis himalayanus*, Warwick," Jardine's Nat. Libr. t. 24 (not good).

Hab. Himalaya (*Cross, Warwick*).

Skull short, broad, length $4\frac{1}{4}$ inches, width 3 inches 2 lines; face short, broad; nasals moderately broad; forehead convex, rhombic; orbits rather small, incomplete behind. The skull is very unlike that of *Felis viverrina*.

3. On the Tracheal Pouch of the Emu (*Dromæus novæ-hollandiæ*, Vieill.). By JAMES MURIE, M.D., F.G.S., Prosector to the Zoological Society.

History.—Peter J. J. de Fremery, in a concise Academical Thesis upon the Osteology of the Emu, published in 1819*, first pointed out in this struthious bird the existence of an anterior aperture in the trachea.

The late Dr. Robert Knox, when Lecturer on Anatomy at Edinburgh, independently discovered and communicated to the scientific world as new the fact of this bird's possessing a most remarkable "large muscular bag" opening into the windpipe. His paper, "Observations on the Anatomical Structure of the Cassowary of New Holland," was read before the Wernerian Natural History Society on the 26th April, 1823, and subsequently published in the 'Edinburgh Philosophical Journal' for 1823–24, vol. x. p. 132. In the same volume (p. 137) he added "Additional Observations on the Structure of the Trachea in the Cassowary Emu of New Holland," accompanying these by figures, comparing the trachea of the Galeated Cassowary, the Emu, and Golden-eyed Duck.

---

* "Specimen Zoologicum sistens observationes præsertim osteologicas de Casuario Novæ Hollandiæ."

A notice of Knox's papers followed in 'Froriep's Notizen,' no. 127, March 1824.

In the last-mentioned Journal, no. 177, in November of the same year, a short account was given of a dissection performed by Dr. Wedemeyer* in 1822, wherein the claim of the priority of having discovered the tracheal sac in the Emu was asserted, evidently unaware of Fremery's earlier observation.

A full translation of Dr. Knox's two papers appeared afterwards in Meckel's 'Archiv für Anatomie und Physiologie,' 1832, p. 263, &c., with footnotes apparently by Meckel himself; for there succeeds the concluding part of a long Essay† upon the Anatomy of the Indian Cassowary by him, and in which he alludes to the authors I have above referred to. In his 'Systematic Treatise on Comparative Anatomy,' Meckel‡ again recalls the opinions of the previously cited observers.

At the Meeting of the British Association in Bristol in 1836 (Report, p. 97), Dr. Macartney laid before the Section of Zoology and Botany "An Account of the Organ of Voice in the New Holland Ostrich;" and as nothing is said respecting what had already been published, I presume from his statement that he considered the fact new to science. Professor Owen, in his 'Memoir on the Anatomy of the Southern Apteryx (Trans. Zool. Soc. vol. ii. p. 279, communicated in 1838)§, takes notice of Fremery's discovery; but he did not find such a structure existing in the Apteryx. Wagner mentions it in his 'Lehrbuch der Zootomie.' And, finally, Carus figures it in his and D'Alton's 'Tabulæ Anat. compar. illust.' 1848, pars vii. tab. 6. fig. 2.

I have been induced thus historically to call attention to accounts of the tracheal pouch of the Emu, because I find that later writers upon the Struthious Birds have not given sufficient importance to these observations upon this singular organization. Such a structure along with other anatomical differences, well pointed out both by Meckel and Knox in the papers cited, should fairly be taken into account and balanced with other characters, whether dermal or osteological, in order to arrive at not only a natural classification of the family, but its relation to allied groups.

Although the aforesaid sac has so often been made the subject of remark, no one seems to have figured the most important feature in connexion with it—namely, the open anterior slit in the tracheal rings. Dr. Knox's illustration is defective, inasmuch as it is small, and the preparation with the distended sac is shown from behind. Carus's figure, of natural size and from an adult bird, only displays the profile contour of the tracheal expansion.

---

* "Der mit der Luftröhre des Emu Casoars in Verbindung stehende muskulose Beutel," Froriep's Notizen, 1824–25, p. 7.

† The first part of which appeared in the 'Archiv.' for 1830, p. 200.

‡ Traité Général D'Anatomie Comparée par J. F. Meckel, traduit de l'allemand par Dr. Th. Schuster. Paris, 1838, x. p. 402.

§ The disposition of the sac to the trachea is therein correctly stated; but in Prof. Owen's more recent 'Anatomy of Vertebrates,' 1866, ii. p. 220, a slip evidently has occurred, in the statement that the cartilaginous rings are wanting *posteriorly* (whereas *anteriorly* undoubtedly must have been meant).

I bring the present paper before the Members of our Society, partly to give a figure supplying the deficiency just alluded to*, and partly to add fresh observation of facts connected with the size of the sac in the young and old birds, with additional remarks on its probable use.

Structure.—I have been enabled to examine, in all, three birds, which from time to time have died in the Society's Gardens,—the first an adult male, in which, unaware of the nature of the opening in the trachea, I had grave doubts that it might have been occasioned by faulty manipulation with the scalpel on my part. I, however, took a photograph of the portion of the trachea and its deficient anterior chink, which I exhibited at the meeting of the Society. The second bird was an adult female. In this case I carefully examined the trachea in order to ascertain whether the tracheal opening was a natural condition. I subsequently made myself acquainted with the labours of previous observers. The third bird was a young male, and in this I found a very great difference in the size of the sac compared with the older birds.

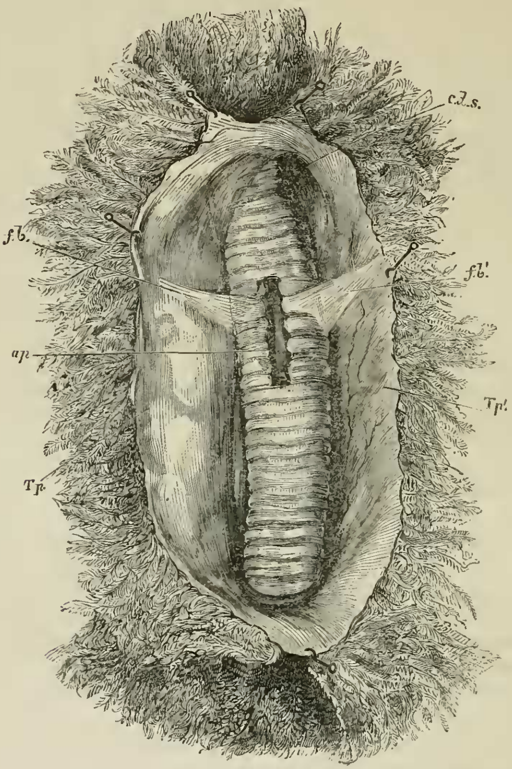
The descriptions of the several investigators spoken of corroborate each other in the main, and to some extent agree with what I have also seen in the adult Emu. I should consider it, therefore, superfluous to redescribe the entire structure, were it not that it enables us to compare the condition of the sac in the old and the young bird, and allows some part of the mechanism to be more fully explained.

In the adult female dissected by me the sac was of large size, and occupied the lower and anterior surface of the neck, its lower end reaching close to the sternum. Its exact shape when distended I did not ascertain; for, thinking I should be able to reflect the skin and tissues covering the bag previous to inflation, I accidentally cut into it while attempting this, the superincumbent coverings and its own walls being very thin. The sac when opened presents an oblong cylindrical form (as shown in fig. 1, *T. p. T. p'.*). Each end is narrowed slightly and comparatively fixed, while the middle portion is freer, thus permitting a certain amount of outward expansion, from the anterior deficiency of the tracheal rings. This no doubt would give it a more oblate spheroidal form when blown up. In Knox's figure, where the sac and trachea are seen from behind, it is represented as being of a globular shape. The trachea in his woodcut appears considerably broader at the sac than above or below, because of the distention of the parts. In the accompanying woodcut (fig. 1), which I have had drawn from nature, it will be seen, however, that in the undistended condition of the pouch the margins of the tracheal opening are not widely separated, the trachea itself being more or less uniform in calibre, while the walls of the sac are rather cylindrical than otherwise.

---

* Since the reading of this paper, Prof. Alfred Newton, of Cambridge, has directed my attention to, and with his accustomed courtesy forwarded me, vol. vi. of the 'Naturalist' magazine (1856), where in the July number, p. 153, is a "Notice of a peculiar Organ in the Trachea of the Emeu," communicated by Mr. Robert Anderson. Two woodcuts accompany the short paper, and one of these exhibits the tracheal chink; but both are very poor representations, and convey no idea of the mechanism of the parts. The author states "the opening extends along ten of the rings and dilates at each extremity."

Fig. 1.



Lower portion of the neck of the adult ♀ Emu seen in front, displaying the tracheal pouch (*T.p. T.p'.*) opened and dragged back on either side by hooks. The feathers are cut short at the tips. *ap.* Aperture or deficiency in the tracheal rings. *c. d. s. Cul de sac* of left upper end. *f. b. f. b'.* Fibrous bands which drag outwards the tracheal cartilages during inflation of the sac.

Dr. Knox has compared the size of the sac to that of a man's head; I have found it in the adult female to have the following dimensions when laid open:—Greatest length, taken upon the left side of the trachea, 14½ inches; but over the trachea itself it measured only 11 inches. A little pouch or *cul de sac* (fig. 1, *c. d. s.*) reached upwards on the left side of the trachea for above 3 inches, giving the increased length at this part. This sacculus appears to correspond with a similar dilatation observable in Knox's figure. The breadth about the middle of the sac, or its rough diameter, was between 3 and 4 inches.

My examination of the structure of the wall of the sac agrees with Wedemeyer and Macartney's observations, and not with Knox's, who describes it as a muscular bag. I find it to be composed of membranous white fibro-elastic tissue, overlaid, however, in part with some very delicate and widely scattered transversely striped muscular fibre, the remnants or representative of the platysma myoides. (Professor Owen* names this the "constrictor colli;" and remarks, "this muscle is well developed in the Emeu, and acts when the drum-like dilatation of the windpipe is sounded.") The skin and subcutaneous tissues form the anterior boundary of the sac; while posteriorly it lies upon the vessels and muscles of the ventral surface of the neck, some of the former appearing as raised cords on its inner surface. Its fibrous envelope furthermore closely invests the anterior surface of the trachea, and at the fissure, presently to be described, appears almost to be continuous with the mucous tissue of the lining walls of the trachea itself. Traced in this way it seems like a kind of hernia of the lining membrane of the trachea, strengthened by the surrounding fibrous and other tissues. But at the same time it must be noted there is a visible though faint line of demarcation around the opening, at 0·2 inch from its edge.

The opening from the trachea into the sac (fig. 1, *ap.*), caused by deficiency of the tracheal rings in front, is $2\frac{3}{4}$ inches long; and the slit has an average breadth of 0·3 inch in the ordinary retracted condition, but when pulled apart it becomes of a very much wider oval figure.

In the female bird in question its position was between the fifty-fourth and fifty-ninth rings; in the young male between the fifty-eighth and sixty-third. Knox asserts there are about thirteen tracheal rings deficient, and that it commences at the fifty-second. Fremery's observation agrees more nearly with mine, as he notices its occurrence between the fifty-third and sixty-second rings. Wedemeyer gives $2\frac{1}{2}$ inches as the length of the opening.

As shown in fig. 1, on the right side there are six cartilaginous rings which do not meet, but on the left side only five; this is occasioned by the lowermost or fifth ring of the right side bifurcating as it approaches the open interspace. In the first male bird examined by me, in a similar manner, there were seven rings on the right side and six on the left. The photograph exhibited demonstrated this peculiarity.

The edges of the opening are not perfectly straight, but wavy, from the ring-cartilages projecting further than their fibrous interspaces. The edge of the rings beneath and above the opening forming the superior and inferior boundary of the vacuity are slightly emarginated. Between the second and third upper cartilages of the fissure on either side is a small fibrous band-like duplication of the wall of the sac, which stretches outwards and upwards, and seems to bind or form a stay and partial septum to the otherwise yielding wall of the sac (fig. 1, *f. b.*).

---

* Anat. of Vertebrates, 1866, vol. ii. p. 110.

If the sac were distended, these, from their position, would naturally pull outwards, and thus retain the orifice of the tracheal rings in an open state. The trachea itself, no doubt, is kept tense or relaxed according to the degree of contraction exerted by the sterno-tracheal muscles (fig. 2, *S. t. m'*.).

The width of the trachea itself is about $2\frac{1}{4}$ inches; and it has a rather flattened or low arched curve from side to side.

In proceeding to note the differences exhibited in the young male I may say that this bird appeared as if little more than a third of the size of the adult female; but its exact age was not known. In this instance I managed to inflate the sac and raise the tissues from above it, so that the front and distended view was perfect. This is shown in the woodcut (fig. 2), where its diminutive size, as compared with the older female, is very marked.

In the first place its shape was decidedly oval, and it barely reached the borders of the trachea when fully blown out. Its greatest length then was 1·3 inch, and its greatest diameter 1·1 inch. During inflation the rings composing the borders of the opening rose up and became stretched outwards, giving an oval contour to the slit itself. There were five rings on either side of the opening, and above this fifty-eight rings, four rings lower therefore than in the adult female. The walls of the sac in the young bird under consideration were very thin and transparent, and seemed almost a continuation of the areolar tissue covering the trachea, but more directly springing from the cartilaginous edges of the longitudinal slit. When uninflated the sac could not be distinguished from the tissues of the trachea, and the slit in the windpipe shone distinctly through. The distance between the upper larynx and the anterior end of the opening was 15 inches. The opening itself was 1·1 inch long and 0·2 broad, and from its lower end to the sternum 3 inches.

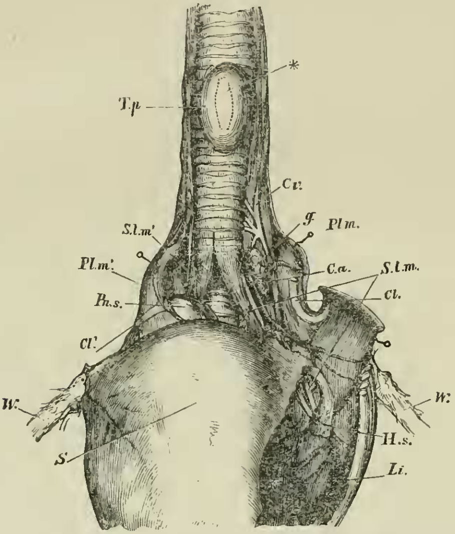
This observation goes to prove that in the young Emu the tracheal sac is insignificant in proportion compared with the size that it afterwards attains. Its parietes then are also of extreme tenuity, and do not show any trace of vascularity. Moreover the differences existing in the two specimens here described, as also in the two birds examined by Fremery and Knox, are evidence of the opening occurring at no regular fixed ring, counting from above, the limits being in these cases between the fifty-second and fifty-eighth rings.

Lastly, it exists both in the male and female sex, as found by Fremery and myself. But Fremery has not noted whether the males or females have the largest sacs, and my own observations do not permit me to state positively regarding this point. In the adult male the tracheal opening was certainly as large as in the female; but, not being aware of the nature of the sac before the parts were cut through, I did not make sure of this point. It certainly was very much smaller in the young male bird; but imperfect development must be taken into account.

Function.—I have so far explained the appearances and differences in the stages of development of this remarkable appendage in the young and adult Emu. When, however, the function which it performs in the animal's economy is inquired into, greater difficulty is found in satisfactorily demonstrating its definite nature and use than in merely describing its structure.

Fremery, the original discoverer, supposed the tracheal opening to be in some way connected with the well-developed thoracic air-sacs in this bird, and so to subserve the respiration and sanguification of the blood while running at a high speed.

Fig. 2.



Portion of thorax and neck of young ♂ Emu partially dissected, and with the ribs on the left side thrust outwards from the sternum (*S*) to show the insertion of the sterno-tracheal muscle (*S. t. m. S. t. m'.*). *T. p.* Tracheal pouch. * points to the dotted line indicating the tracheal aperture. *S.* Sternum. *S. t. m. S. t. m'.* Sterno-tracheal muscles (on the left side the pointer only reaches the thoracic vein instead of the muscle lying beyond). *C. a.* Carotid artery. *C. v.* Carotid vein. *g.* Gland. *Pl. m.* Platysma myoides. *Pn. s.* Pneumatic sac. *Cl. Cl'.* Clavicles. *W. W'.* Wings, cut short. *H. s.* Hyosternal process (Geoff.) (costal process of some writers). *Li.* Liver.

Dr. Knox has very oddly suggested the use of the sac as a swimming-bladder. Alluding to the occasional sudden inundations of the Australian plains and the termination of the rivers in marshes in that country, he says:—"The Emu, forced to seek his food amidst these fens, may, when obliged to have recourse to swimming (which must often be the case), fill the muscular bag of the trachea with air, and thus convert it into a swimming-bladder."

He further remarks it may be useful in running; for "by its means and the precaution of shutting the glottis the bird will be enabled to cause the air of one inspiration to pass and repass the lungs, without being necessitated to allow it to escape, in order to perform the act of inspiration" (ibid. pp. 136–139).

Wedemeyer was inclined to regard it as an air-reservoir for oxygenizing the blood, as did Fremery.

Meckel, in summing up the opinions of these authors, gives his own to this effect:—That it has no connexion with the voice, that more probably it facilitates running, and that in exceptional circumstances it may functionally answer as a swimming-bladder.

Dr. Macartney advances the idea that "the peculiar sound belonging to the New Holland Ostrich is entirely occasioned by the reverberation or resonance produced in the membranous bag connected with the front of the trachea," giving analogous instances in the bird, horse, howling-baboon, and bull-frog.

Professor Owen, as already mentioned, at least considers there is an existing relation between the sac and the sound. Dr. George Bennett* states, "the only sound emitted by the Emeu is a sort of hollow booming note. It is considered to be produced in the female by means of the expansion and contraction of a large membranous bag surrounding an oblong opening through the rings of the trachea."

Mr. Bartlett, Superintendent of the Society's Gardens, has made many observations on the voices and habits of the Struthious Birds living in the Society's Menagerie.

On discussing the mooted question of the use of the sac with him, he supplies me with the following information:—"I have no reason to believe the sac and opening in the trachea in the Emu have anything whatever to do with swimming, breathing, or running, but I consider them as constituting simply the organ of sound employed by both male and female during the breeding-season. Probably at other times the sound produced by the female is louder and of a more regular drumming kind than in the male bird, also the lower part of the neck is inflated to a much greater extent in the female than in the male during the time these sounds are emitted. I am, moreover, unable to say whether the cavity is larger in the female than in the male."

In offering my own opinion upon the supposed function of this very remarkable tracheal appendage, unknown in any other species of bird, I must confess myself very undecided concerning its adaptation to one special use. Placing the opinions of the several authorities in a tabular form they may be stated as follows:—

1st. Respiratory purposes (oxygenation of the blood).
2nd. As a swimming-bladder.
3rd. As an air-reservoir in running.
4th. For simple vocal resonance.
5th. Sexual organ of sound during the breeding-season.

With respect to the first of these assigned functions, this may be looked at in a twofold view. The sac may either be regarded as a membranous expanse, the vascularity of which permits it to deoxygenize the inspired air, as does the lung; or it may merely supply the place of an air-reservoir to the lungs themselves. The first of these two considerations involves the idea of the sac's possessing a structure analogous to those found in the respiratory surfaces generally. But so far as tissue is taken into account, its examination, by former observers as well as myself, does not show its texture to be sufficiently rich in vascular network to perform the function of aërification, at least such aërification as might be supposed to be required in a warm-blooded vertebrate.

---

* Gatherings of a Naturalist in Australia (London, 1860), p. 219.

No doubt this tracheal pouch might correspond to the thoracic and other pneumatic cavities which are present in this as in many other birds, these, as some maintain (an opinion I am inclined to adopt), subserving the purposes of respiration rather than that of buoyancy in flight, which formerly was considered their function. But as the act of filling the tracheal sac, unlike the other pneumatic chambers, involves unusual and highly increased muscular efforts, and as the sac does not, so far as has been observed in the living bird, retain regularly or dilate synchronously with ordinary respiration, it would follow that, in a mere occasional dilatation, so little advantage would accrue that one can hardly believe it possible that the physiological changes would be of the same nature as those occurring in the bone-cavities &c.

Concerning the second use, namely, as a swimming-bladder, the reasoning seems far-fetched. It is true that the Emu alone of all the struthious birds is known to take readily to the water; but the amount of buoyancy which such an air-sac would confer hardly seems equal to the occasion. If the bird depended on such an apparatus alone, muscular effort on its own part would far outbalance such a structure; and, moreover, in swimming-birds generally no such appliance is required, they remaining floating about for a long period, while the Emu, at most, would, in the event of crossing a swollen current, dash right through the watery element.

In considering the third suggested use, for running-purposes, if we found its presence in all the species of *Struthionidæ*, or such a structure in other animals noted for their speed of foot, we might the more readily believe it a necessity and adjunct to fleetness of progression. But this tracheal pouch, be it remembered, is strictly confined to *Dromæus novæ-hollandiæ*, and is found in no other species of the group, and, as I shall hereafter show, it occurs in a well-developed manner in slow-moving Reptilians, invalidating the idea of its being an accessory to celerity of motion. Besides the phenomenon of inflation has not been observed to take place in rapid movement, but rather at quieter times and at the will of the bird.

As for the fourth use, simple vocal resonance, this indeed may be augmented by the chamber in question; but that it represents a special organ of voice is, to say the least of it, doubtful. The comparison between the tracheal enlargement of Ducks and this sac does not strengthen the argument, as it is remarkable that the females of such birds often have the loudest voice, though no tracheal enlargement is present; whereas its presence in the males is not necessarily conjoined with voluminous vocal powers.

Regarding the fifth assigned use, the sexual organ of sound during the breeding-season, this seems a more reasonable one, inasmuch as there are many instances of appearances and habits being temporarily assumed in birds during the breeding-time—*e. g.* the wattles of the Tragopan, and gular pouch of the Bustard &c. It agrees also with the fact that inflation of the sac is more often noticed then, and the peculiar drumming-noise is very frequent under sexual excitement.

The phenomena accompanying distention of this tracheal pouch in the birds in the Society's Gardens, as I have observed them, are as follows:—The head and the neck are slightly raised, the latter somewhat bent; then there appears a swelling in the lower part of the neck, and the bird with partly opened mouth gives utterance to a series of grunting-like sounds, during which there is observable a tremulous-like motion in the distended lower part of the neck, while a certain compressed state of the glottis appears to take place. The physiological action seems to be first a deep inspiration, followed by expiration of a forced kind with total or partial closure of the glottis, the tracheal pouch then fills, the aperture is more or less dilated, and as the glottis is temporarily and successively relaxed the air rushes from the lungs towards the open mouth, and, passing the orifice of the sac in jets, gives rise to the peculiar hollow metallic sounds, as does air when blown over the open bunghole of a cask.

When an organ or appendage admits of so many ingenious suppositions as to its function as have been assigned to the one here treated of, it is not surprising that the precise one should remain uncertainly known. Interpreting the nature of the tracheal pouch from structure and position, as well as the mode and times of its being called into action, with the fact that the sac increases from the young to the adult stage, and that its maximum of size and apparent use correspond with the period of the procreative faculty, the following seems to be its use:—that it serves as an organ of sound employed by the bird under the phenomena incident to the passion of lust, and hence is more powerfully brought into play during the breeding-season.

Homology.—It is not my intention in the present communication to enter largely into the homology of this tracheal sac. Its wider relations in a homological sense evidently possess as much of interest as does the more limited study of its œconomical function in the Emu. I shall therefore only advert to the probable direction in which its homology is to be studied, by referring to a note by the French translators of Meckel's 'Vergleichende Anatomie,' "Ce sac peut être comparé aux sacs laryngiens des *sauriens,* à raison de l'influence qu'exerce la volonté de l'animal sur la distention de cette poche par l'air"*. Among Reptilians, however, the Chameleon, as is well known, possesses a dilatable tracheal sac, in many respects closely resembling that existing in the Emu. In a specimen of this animal which I examined this pouch was of considerable size, and in its textural structure quite like that of the Emu. Instead, however, of being simple and ovoid or globular when distended, as in the Emu, it was pyriform, and with a partially constricted sacculus at

* Edition already cited, tome x. p. 405.

its free or distal extremity. The communicating aperture also was roundish, and placed high up in the trachea, close to the larynx, not slitlike or so low down as in the Emu. It is also worth while here to note that in the dead Chameleon the tracheal sac was with difficulty dilated from the mouth, but pressure on the thorax (representing forced expiration) distended it with ease, a fact corroborative of its mode of action in the living Emu.

With these homological remarks I have said enough to show that the accessory tracheal pouch in the Emu bears out the Reptilian affinities of the *Struthionidæ* which Huxley* and Parker† more clearly bring out from observations on their osteological development.

4. On the Classification of Birds; and on the Taxonomic Value of the Modifications of certain of the Cranial Bones observable in that Class. By Thomas H. Huxley, F.R.S., V.P.Z.S.

The members of the class Aves so nearly approach the Reptilia in all the essential and fundamental points of their structure, that the phrase "Birds are greatly modified Reptiles" would hardly be an exaggerated expression of the closeness of that resemblance.

In perfect strictness, no doubt, it is true that Birds are no more modified Reptiles than Reptiles are modified Birds, the reptilian and the ornithic types being both, in reality, somewhat different superstructures raised upon one and the same ground-plan; but it is also true that some Reptiles deviate so very much less from that ground-plan than any Bird does, that they might be taken to represent that which is common to both classes, without any serious error. A Lizard is not very far from being the centre of the circle, the periphery of which is occupied by Chelonia, Ichthyosauria, Plesiosauria, Pterosauria, and Aves.

That the association of Birds with Reptiles into one primary group of the Vertebrata, the Sauropsida, which I have proposed elsewhere, is not a mere fancy, but that the necessity of such a step is as plain and demonstrable as any position in taxonomy can be, appears to me to be proved by an enumeration of the principal points in which Aves and Reptilia agree with one another and differ from Mammalia.

1. They are devoid of hair.
2. The centra of their vertebræ have no epiphyses.
3. Their skulls have single occipital condyles.
4. The prootic bone either remains distinct throughout life, or unites with the epiotic and opisthotic *after* these have become anchylosed with the supraoccipital and exoccipital.
5. The *incus* and *malleus* are not subservient to the function of hearing as *ossicula auditus*.

---

* Elements of Comp. Anat. 1864, i. (and unpublished Hunterian Lectures, 1867).

† Philosophical Transactions, 1866, pp. 113–183.

6. The mandible is connected with the skull by the intermediation of a quadrate bone (which represents the *incus* of Mammalia).

7. Each ramus of the mandible is composed of a number of separate ossifications, which may amount to as many as six in all. (Of these the *articulare* represents the *malleus* of Mammalia).

8. The apparent "ankle-joint" is situated not between the *tibia* and the *astragalus* as in the Mammalia, but between the proximal and the distal divisions of the *tarsus**.

9. The brain is devoid of any *corpus callosum*.

10. The heart is usually provided with two aortic arches; if only one remains, it is the right.

11. The red blood-corpuscles are oval and nucleated.

12. The cavities of the thorax and abdomen are never separated by a complete diaphragm.

13. The allantois, which is highly vascular, is very large, and envelopes the embryo; but no villi for placental connexion with the parent are developed upon it.

14. There are no mammary glands.

I attach less weight to the first of these characters than to the rest, since the simpler kinds of feathers very closely approach hair in structure and development; but the other thirteen are, for the most part, of extreme importance, and define Birds and Reptiles, as a whole, very sharply from Mammals.

Closely as Birds approach Reptiles, however, and small as the divergence of the ornithic type from the reptilian appears to be, in view of the great divergences of Reptiles from one another, there are still a number of characters common to Birds which are absent in all recent Reptilia, and, so far as our knowledge goes, in extinct Reptiles—though it must be carefully borne in mind that our information respecting the latter is limited to an acquaintance with their osteology. Thus—

1. Birds possess epidermal appendages developed in sacs of the dermis, and having the structure of feathers.

2. More or fewer of the anterior vertebræ have centra with cylindroidal articular surfaces†.

3. Although all birds possess a remarkably large sacrum, the vertebræ, through the intervertebral foramina of which the roots of the sacral plexus (and, consequently, of the great sciatic nerve) pass, are not provided with expanded ribs abutting against the ilium externally, and against the bodies of these vertebræ by their inner ends.

In recent Reptiles, possessing well-developed hind limbs, the intervertebral foramina through which the roots of the sciatic nerve pass* are wholly, or in part, bounded by vertebræ provided with thick and expanded ribs; and these ribs are connected, more or less extensively, on the one hand, with the bodies of these vertebræ, and on the other with the iliac bones. The vertebræ in question, of which there are ordinarily two, constitute the sacrum. In Birds the arches of the vertebræ which correspond with these in their relation to the nerves (and therefore must also be termed "sacral") give off comparatively slender transverse processes, which seem to answer to those which unite with the tubercles of the ribs in the dorsal region; and it is by these transverse processes only that they are connected with the ilia.

---

* See Gegenbaur, 'Archiv für Anatomie' (1863), and 'Untersuchungen zur vergleichenden Anatomie' (1864).

† *Archæopteryx* may possibly prove an exception to this rule. When certain of the vertebræ of Birds (as in the Penguins, *Larus fuscus*, and others) have centra with spheroidal articular surfaces, the anterior faces of the centra are convex and the posterior concave, which is the rarest case among the Reptilia. The procœlous form of vertebra, so common among the Reptilia, has not been observed in the cervical or dorsal regions of the spine of Birds.

4. The broad and expanded part of the sternum, which immediately follows the coracoidal articular surfaces, receives all the sternal ribs. In all recent Reptilia which possess sternal ribs, some of the latter articulate with narrow prolongations, which extend back from the posterior angle of the expanded rhomboidal sternal plate. The sternum in Birds ossifies in a manner which has not been observed in any Reptile.

6. The ischia never unite in a median ventral symphysis; and both pubes and ischia are directed backwards, approximately parallel with one another and with the spinal column.

7. The proximal constituent of the tarsus is anchylosed with the tibia into one tibio-tarsal bone†; the distal element of the tarsus similarly unites with the second, third, and fourth metatarsal bones, and gives rise to the tarso-metatarsal bone. The metatarsal of the hallux is shorter than the others, and does not reach the tarsus.

Unless, as Gegenbaur has rendered probable, the hind limb of the extinct reptile *Compsognathus* was similarly modified, these characters are diagnostic of birds. In any case they are highly characteristic of them.

8. Birds have hot blood, a muscular valve in the right ventricle, a single aortic arch, and remarkably modified respiratory organs; but it is, to say the least, highly probable that the Pterosauria, if not the Dinosauria, shared some of these characters with them. The amount of work involved in sustaining a Pterodactyle in the air would seem, physiologically, to necessitate proportional oxidation and evolution of waste products in the form of carbonic acid. If so, a proportional quantity of heat must have been evolved, and there must have been a ready means of eliminating the carbonic acid from the blood. We know of no such means, except those which are afforded by highly developed circulatory and respiratory organs; and therefore it is highly probable that the Pterodactyles had more perfect

---

* The sciatic nerve of the Crocodile is formed, for the most part, by a root which leaves the spinal canal by the intervertebral foramen, interposed between the two sacral vertebræ, and which passes between the two expanded sacral ribs. It receives a large accessory branch from the preceding, and a smaller from the succeeding, spinal nerve. In *Gecko verus* the root of the sciatic nerve, which passes out between the two sacral vertebræ, is smaller than that which lies in front of it, between the anterior sacral and the last lumbar vertebræ.

† See Gegenbaur, *l. c.*

organs of this kind than their congeners, accompanied by the correlative hot blood.

But since we know that the organs of respiration and circulation of a Bat are very different from those of a Bird, it is quite possible that those of a Pterodactyle may have been different, in detail, from either.

Having thus arrived at the conclusion that the class Aves, while well enough defined from all existing Reptiles, is nevertheless far more closely connected with the class Reptilia than with any other, I proceed to inquire how Birds may be subdivided into orders, suborders, and families, by characters equalling, or at any rate approaching, in definiteness those which mark out the corresponding groups among Mammals and Reptiles.

I propose to divide the class Aves into three orders: the Saururæ, the Ratitæ, and the Carinatæ.

I. The Saururæ (Haeckel) are represented by the solitary fossil *Archæopteryx*, which seems to have been distinguished from all other birds by the following characters:—

1. The metacarpal bones are well developed, and are not anchylosed together.

2. The caudal vertebræ are both numerous and large, so that the caudal region of the spine is longer than the body, whereas in all other birds it is shorter than the body.

The furculum is complete and strong, and the foot extremely passerine in appearance. The forms of the skull and of the sternum are unknown*.

II. The Ratitæ (Merrem), or the Struthious Birds, differ from all others in the combination of the following peculiarities:—

1. The sternum is devoid of a crest, and ossifies only from lateral and paired centres.

2. The long axes of the adjacent parts of the scapula and coracoid are parallel or identical†. The scapula has no acromial process, nor has the coracoid any clavicular process; at most there are inconspicuous tubercles representing these processes.

3. The posterior ends of the palatines and the anterior ends of the pterygoids are very imperfectly, or not at all, articulated with the basisphenoidal rostrum, being usually separated from it, and supported, by the broad, cleft, hinder end of the vomer.

4. Strong "basipterygoid" processes, arising from the body of the basisphenoid and not from the rostrum, articulate with facets which are situated nearer the posterior than the anterior ends of the inner edges of the pterygoid bones.

5. The upper, or proximal, articular head of the quadrate bone is not divided into two distinct facets.

---

* The "retention of two unguiculate digits on the radial side of the metacarpophalangeal bones modified for the attachment of the primary quill-feathers" (Philosophical Transactions, 1863, p. 46) is no distinctive character of *Archæopteryx*, both *Struthio* and *Rhea* presenting "two unguiculate digits" in the manus.

† My friend Professor Newton informs me he had already drawn attention to this important point in his Lectures delivered at Cambridge last autumn.

6. The barbs of the feathers are disconnected.

7. There is no inferior larynx, and the diaphragm is better developed than in other birds.

Though comparatively but few genera and species of this order now exist, they differ from one another very considerably, and have a wide distribution, from Africa and Arabia over many of the islands of Malaisia and Polynesia to Australia and South America. Hence, in all probability, the existing Ratitæ are but the waifs and strays of what was once a very large and important group.

The Afro-Arabian genus *Struthio* is the type of one group of this order, characterized by:—

1. The prolongation of the maxillary processes of the palatine bones forwards, beneath the maxillo-palatines*, as in most birds.

2. The thickening of the inner edges of the maxillo-palatines, and their articulation with facets upon the sides of the vomer.

3. The shortness of the vomer, which does not articulate with either palatines or pterygoids posteriorly.

4. The slight, or wanting, ossification of the prefrontal processes of the primordial cranium.

5. The union of the bodies of the sacral vertebræ with the anterior ends of the pubes and ischia.

6. The presence of two shallow notches, on each side, in the posterior margin of the sternum.

7. The proportions of the fore limb. The humerus is about equal in length to the distance between the pectoral arch and the ilium, and is therefore much longer than the scapula. The antebrachium is not half as long as the humerus. The manus possesses the ordinary three digits; and two of these, the radial and the middle, are provided with claws†.

8. The union of the pubes in a symphysis.

9. The abortion not only of the hallux, but also of the distal end of the metatarsal bone and of the phalanges of the second digit of the foot, whence the foot is two-toed.

10. The presence of thirty-five precaudal‡ vertebræ.

11. The feathers being devoid of aftershafts.

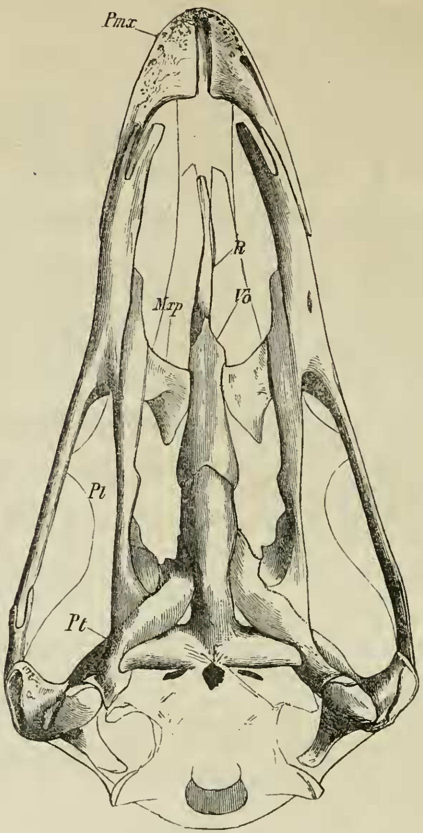
---

* By the term "*maxillo-palatines*" I designate those processes of the maxillary bones which extend, more or less horizontally, inwards and contribute to the formation of the roof of the mouth and the anterior and inferior walls of the nasal chambers. Nitzsch called them "Muscheltheile." Mr. Parker has included them, with the maxillæ of which they form a part, under the head of *prevomers*. I conceive these maxillo-palatine processes to answer to the palatine processes of the maxillary bones in the Mammalia.

† This interesting fact was first noted by Nitzsch ('Osteografische Beiträge,' p. 91), but has since been forgotten.

‡ I regard as "caudal" all those vertebræ of the bird's complex "sacrum" which lie behind the exit of the roots of the sacral plexus. The foremost of these caudal vertebræ are readily distinguished from the proper sacral vertebræ, which immediately precede them, by possessing inferior transverse processes, or, more strictly speaking, anchylosed ribs, which, like flying buttresses, pass from the bodies of the vertebræ upwards and outwards to the roof of the "sacrum" at its junction with the ilium.

Fig. 1.



Under view of the skull of *Struthio camelus.* From a specimen in the Museum of the Royal College of Surgeons.

Pmx. The præmaxillæ. *R.* The sphenoidal rostrum. *Vo.* The vomer. *Pl.* The palatine bone. *Mxp.* The maxillo-palatine plate of the maxillary. *Pt.* The pterygoid.

A second group is represented by the South American genus *Rhea,* in which—

1. The maxillary processes of the palatines are short, and unite with the inner and posterior edges of the maxillo-palatines.
2. The maxillo-palatines are thin, fenestrated plates, which do not articulate with facets on the edges of the vomer.
3. The vomer is as long as it usually is in birds, and articulates behind with the palatine and pterygoid bones.

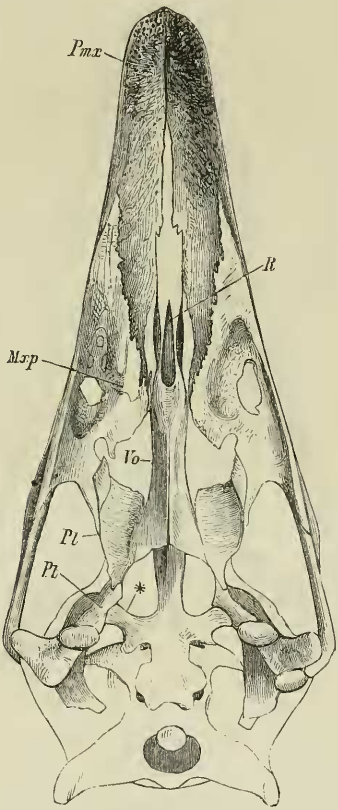
4. The prefrontal processes are little ossified.

5. The bodies of the proper sacral vertebræ do not unite with the pubes or ischia; and the centra of the sacral vertebræ, which ossify late, are extremely elongated and slender.

6. The short sternum narrows posteriorly, and presents a notch in the middle of its posterior edge.

7. The length of the humerus exceeds the distance between the shoulder-girdle and the ilium, and is of course greatly longer than the scapula. The manus has the same conformation as that of *Struthio*.

Fig. 2.



Under view of the skull of *Rhea americana*.

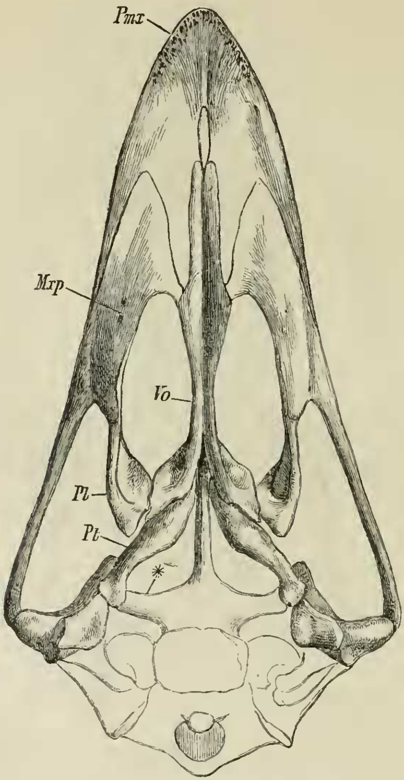
Pmx. The præmaxillæ. *R*. The rostrum. *Mxp*. The maxillo-palatine. *Vo*. The vomer. *Pl*. The palatine. *Pt*. The pterygoid. * The basipterygoid process of the sphenoid.

8. The pubes are free; but the ischia unite beneath the urosacral* vertebræ.
9. The hallux is absent; but the second, third, and fourth digits are complete.
10. There are only thirty-two precaudal vertebræ.
11. The feathers are devoid of an aftershaft.

The Malayo-Australian genera *Casuarius* and *Dromæus* are members of a third group, which may be defined as follows:—

1. The maxillary processes of the palatines are short, as in *Rhea*.

Fig. 3.



Under view of the skull of *Dromæus novæ-hollandiæ*. From a specimen in the Museum of the Royal College of Surgeons.

The letters have the same signification as in the preceding figures.

---

* I term "urosacral" those caudal vertebræ which unite with one another and with antecedent vertebræ to form the "sacrum" of a bird.

2. The maxillo-palatines are flat, imperforate plates, which unite solidly with the præmaxillæ and the vomer.

3. The vomer is long, and articulates behind with the palatine and pterygoid bones.

4. The prefrontal processes are large and well ossified.

5. The bodies of the proper sacral vertebræ do not unite with the pubes or ischia; and the bodies of the urosacral vertebræ are very large, thick, and well ossified.

6. The sternum is long and escutcheon-shaped, at first widening and then coming to a point behind.

7. The humerus is not nearly half so long as the distance between the pectoral arch and the ilium, and is much shorter than the scapula. The antebrachium is not more than half as long as the humerus. Only one digit, the median, is complete and bears a claw.

8. Neither the pubes nor the ischia unite in the middle line of the body.

9. The hallux is absent, but the other digits are complete.

10. There are thirty-five precaudal vertebræ.

11. The feathers have aftershafts as long as the principal shafts.

The extinct *Dinornis* of New Zealand differs from the other Ratitæ, and thus represents a fourth group, in exhibiting:—

1. A skull with high arched beak and projecting occipital condyle.

2. Flat, imperforate maxillo-palatine plates, which unite solidly with the præmaxillæ and probably with the vomer, as in *Dromæus*.

3. A Dromæine pelvis.

4. A broad sternum with two posterior notches.

5. A very rudimentary pectoral arch, which appears to have possessed no glenoidal cavity for the articulation of the humerus.

6. Three toes, the hallux being absent.

7. The feathers have an aftershaft*.

Lastly, the remarkable living New Zealand genus *Apteryx* represents a fifth division, having:—

1. The palatines short and broad, and uniting by an oblique suture with the expanded maxillo-palatines, which are flat, imperforate plates uniting with the premaxillaries and the vomer.

2. The vomer long and uniting with the palatines and pterygoids posteriorly.

3. The prefrontal processes very large and spongy.

4. The bodies of the proper sacral vertebræ not united with the ischia or pubes; the urosacrals large and well ossified.

5. The sternum broad and with two posterior excavations.

6. The humerus longer than the scapula, and extending for about half the distance between the pectoral arch and the ilium. The antebrachium about half the length of the humerus, and the manus possessing but one claw.

7. Neither the pubes nor the ischia united in the middle line of

---

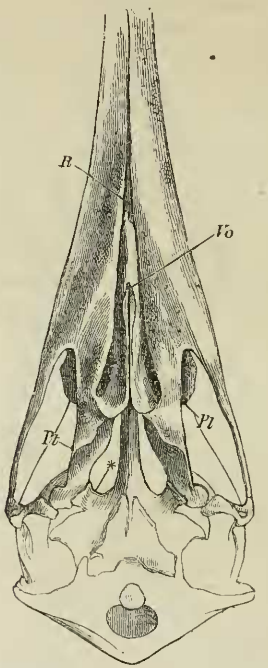
* See Dallas, Proceedings of the Zoological Society, 1865.

the body; nor are the pubis and the ischium of the same side united by bone.

8. The hallux present, as well as the other three digits of the foot.
9. Only thirty-two precaudal vertebræ.
10. The feathers without any aftershaft.

It will be observed that in each of these families of the Ratitæ a particular form and arrangement of the bones of the palate accompany the other distinctive characters.

Fig. 4.



Under view of the skull of *Apteryx australis*. From a specimen in the Museum of the Royal College of Surgeons.

The letters as before.

III. The order CARINATÆ (Merrem) embraces all existing birds, except the Ratitæ. They have the following characters in common:—

1. The sternum possesses a keel, and ossifies from a median centre in that keel, as well as from lateral paired centres*.

---

* The sternum is thus ossified in all the Carinatæ which have yet been examined. The only apparent exception to the presence of a keel is the singular genus *Strigops*. A knowledge of the ossification of the sternum of this bird is greatly to be desired.

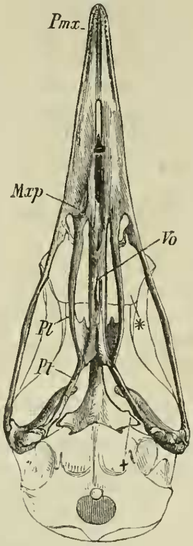
2. The long axes of the adjacent parts of the scapula and coracoid make an acute or a slightly obtuse angle, and are never, even approximately, identical or parallel[*]. The scapula always has a distinct acromion and the coracoid a clavicular process.

3. The vomer is comparatively small, and allows the pterygoids and palatines to articulate directly with the basisphenoidal rostrum[†].

In this order the bones which enter into the formation of the palate are disposed in four different modes, which may be called respectively the *Dromæognathous, Schizognathous, Desmognathous,* and *Ægithognathous* arrangement.

I. The *Dromæognathous* Birds are represented by the single genus *Tinamus,* which (as Mr. Parker has shown[‡]) has a completely struthious palate. In fact the vomer is very broad, and in front unites with the broad maxillo-palatine plates, as in *Dromæus*; while behind

Fig. 5.



Under view of the skull of *Tinamus robustus.* From a specimen belonging to W. K. Parker, Esq., F.R.S.

The letters as before, except * the prefrontal, and + the basipterygoid, process.

---

[*] The only genera in which, so far as I know, this angle is somewhat greater than a right angle are *Ocydromus* and *Didus.*

[†] *Tinamus* perhaps affords an exception to this character.

[‡] "On the Osteology of the Gallinaceous Birds and Tinamous" (Transactions of the Zoological Society, vol. v., 1864). Sundevall, however, had already said of *Tinamus, Rhynchotus,* and *Crypturus,* "Struthiones parvos referunt."

it receives the posterior extremities of the palatines and the anterior ends of the pterygoid bones, which thus are prevented, as in the Ratitæ, from entering into any extensive articulation with the basisphenoidal rostrum.

The basipterygoid processes spring from the body of the sphenoid, not from its rostrum, and they articulate with the pterygoids very near the distal, or outer, ends of the latter bones. The head of the quadrate bone is single, as in the Struthious birds (Parker, *l. c.*).

But the sternum of *Tinamus* has a great crest, and the coracoid and scapulæ have the arrangement and structure usual in the Carinatæ. And though the ischium is not united with the ilium by bone behind the acetabulum, so that the sciatic notch is not converted into a foramen by bone, this character is not universal among the Ratitæ, and, in *Tinamus,* a fibrous or cartilaginous bridge does connect the two bones.

Though the most Struthious of all Carinate birds, then, *Tinamus* cannot, I think, be removed from the order of the Carinatæ.

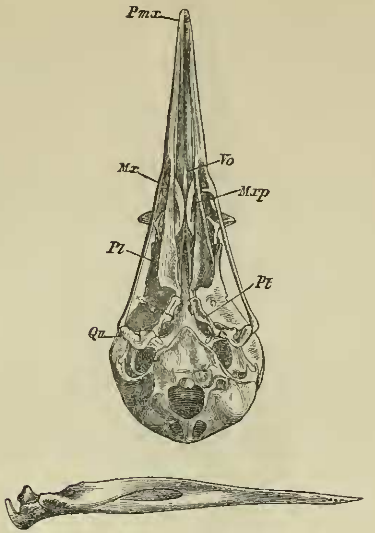
II. In the large assemblage of birds belonging to the Cuvierian orders Gallinæ, Grallæ, and Natatores, which may be termed *Schizognathous,* the vomer, sometimes large and sometimes very small, always tapers to a point anteriorly; while posteriorly it embraces the basisphenoidal rostrum, between the palatines. But the latter bones and the pterygoids are directly articulated with one another and with the basisphenoidal rostrum, and are not borne by the divergent posterior ends of the vomer.

The maxillo-palatines are usually elongated and lamellar; they pass inwards over the anterior processes of the palatine bones, with which they become united, and then bending backwards, along the inner edge of the palatines, leave a broader or a narrower fissure between themselves and the vomer, and do not unite with it or with one another.

This Schizognathous arrangement of the palatine bones is extremely well displayed by the Plover, as the accompanying figure of the parts in *Charadrius pluvialis* shows.

The palatine bone (fig. 6, *Pl*) presents an expanded part, which may be called its "*body,*" the inner and outer edges of which are produced into internal and external "*laminæ,*" separated by a longitudinal groove or depression. In this bird the outer lamina descends much further than the inner. The free edge of the outer lamina joins the posterior margin nearly at a right angle, and thus gives rise to the "*postero-external angle.*" The postero-internal angle of the body of the bone is produced into a "*pterygoid process,*" which articulates with the pterygoid posteriorly, and with the basisphenoidal rostrum internally. Superiorly the body of the palatine bone passes into what may be termed its "*ascending process,*" which bends round so as to form the posterior boundary of the nasal passage, and ends, on the inner side of that passage, in a slender prolongation which passes forwards and applies itself to one of the forks of the vomer (fig. 8, *Vo*).

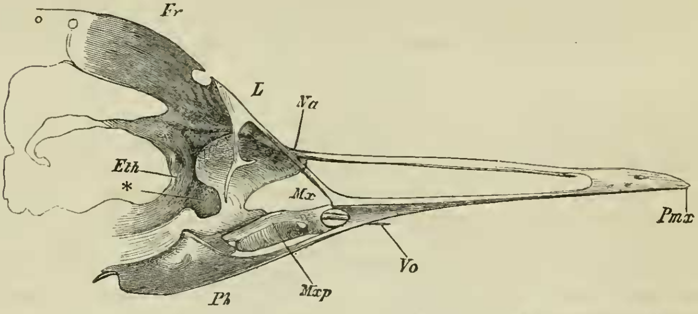
Fig. 6.



The inferior face of the skull, and a lateral view of the outer side of the right ramus of the mandible, of *Charadrius pluvialis*; of the size of nature.

Pmx. The præmaxilla. *Mx*. The maxilla. *Mxp*. Its maxillo-palatine process. *Pl*. The palatine bone. *Pt*. The pterygoid bone. *Qu*. The quadrate bone. × The basipterygoid process.

Fig. 7.

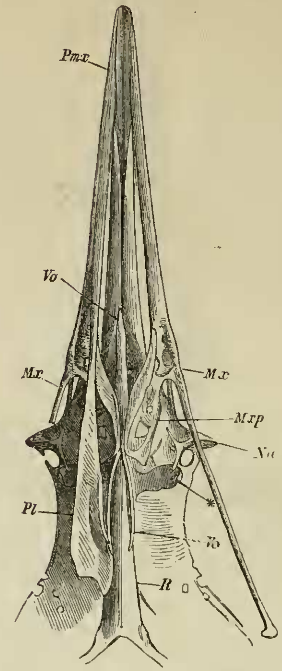


A side view of the fore part of the skull of *Charadrius pluvialis*, enlarged.

Pmx, *Mx*, *Mxp*, *Pl*, as before. *Na*. The nasal bone. *Fr*. The frontal. *Eth*. The ethmoid. *L*. The lachrymal. * The ossified prefrontal process of the ethmoidal cartilage, which separates the orbital from the nasal chamber.

Anteriorly the body of the palatine gradually narrows into its "anterior" or "*maxillary process*," the origin of which is coincident with the abrupt termination of the inner lamina. The slender anterior

Fig. 8.



Under view of part of a skull of *Charadrius pluvialis*, partially dissected and enlarged. The letters as before, except *R*, the basisphenoidal rostrum. The left palatine bone is removed, so as to expose the whole under face of the maxillo-palatine and prefrontal processes, and the left half of the hinder split moiety of the vomers.

extremity of this process coalesces with the maxillary and premaxillary bones of its own side. The vomer is deeply cleft behind, and embraces the sphenoidal rostrum by its two slender forks (fig. 8). In front it becomes flattened and slightly decurved (fig. 7), ending in a point opposite the level of the union of the palatines with the maxillaries and premaxillaries. Immediately behind the place at which the maxilla (*Mx*) gives off its ascending process to join the external descending process of the nasal (*Na*), it sends a slender stem of bone inwards; and this almost immediately expands into the oval, scroll-like, maxillo-palatine plate (*Mxp*), the convex face of which looks upwards and inwards, while its concave face looks downwards and outwards. The maxillo-palatine has an abruptly truncated posterior free edge, while in front it tapers off and becomes united with the upper surface of the maxillary process of the palatine (fig. 8). In the middle line, its rolled edge, which lies on the inner side of the maxillary process, comes very near that of its fellow; but it remains perfectly distinct from the other maxillo-palatine and from the vomer. The plate is perforated by four holes, between which a sort of St. Andrew's cross of bone is left (fig. 8).

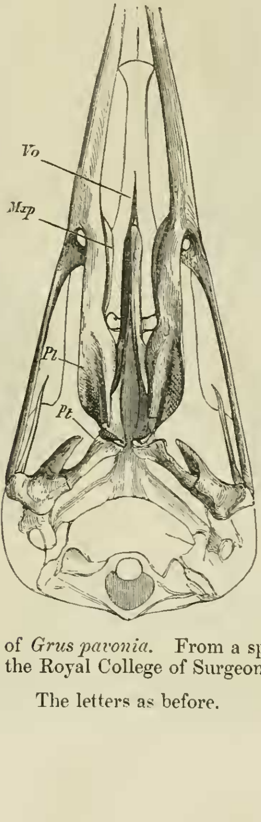
It follows from this description that, in the dry skull of the Plover, the blade of a thin knife can be passed, without meeting with any bony obstacle, from the posterior nares alongside the vomer to the end of the beak.

On each side of its commencement the basisphenoidal rostrum presents a small elevation, terminated by a flat oval facet (fig. 6, ×), which represents the basipterygoid process of the Ratitæ. A corresponding facet on the inner edge of the pterygoid bone, nearer its anterior than its posterior end, articulates with this (fig. 6).

The angle of the mandible is elongated into a slender process, which bends abruptly upwards, and is frequently broken off (fig. 6).

The Pluvialine form and arrangement of the maxillary, palatine, and pterygoid bones just described are substantially repeated in the following Pressirostres and Longirostres of Cuvier:—*Charadrius, Œdicnemus, Vanellus, Hæmatopus, Cursorius, Scolopax, Numenius,*

Fig. 9.



Under view of the skull of *Grus pavonia*. From a specimen in the Museum of the Royal College of Surgeons.

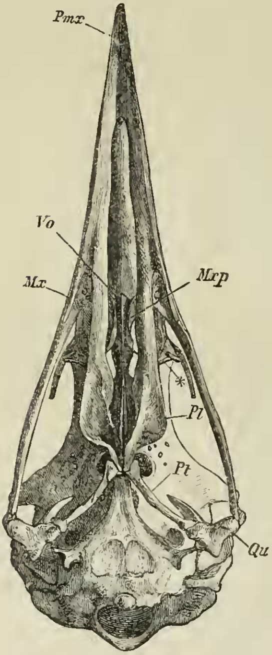
The letters as before.

Rhynchæa, Limosa, Tringa, Machetes, Phalaropus, Strepsilas, Totanus, Himantopus.

The Cranes almost always lack basipterygoid processes and the corresponding facets upon the pterygoids, the only exception I have met with being *Grus antigone*. The Rails are always devoid of basipterygoid processes. In other points the palates of these birds, of *Eurypyga*, of the Kagu, of *Psophia*, and of *Otis* are similar to that of the Plover. The angle of the mandible, however, is obliquely truncated, and not produced into an upwardly curved process.

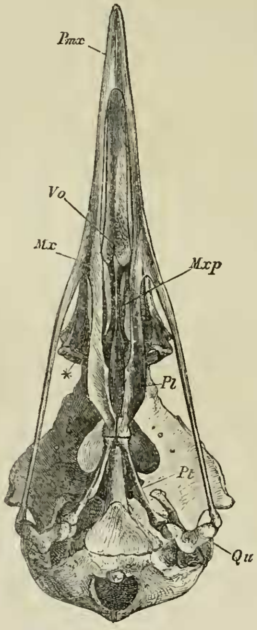
In the Gulls, the Divers, the Grebes, the Auks, and the Penguins, the bones which form the roof of the mouth have the same general arrangement and form as in the Plovers. But they are devoid of basipterygoid processes; and in the Penguins the pterygoids become much flattened from above downwards.

Fig. 10.



Alca torda.

Fig. 11.



Larus rissa.

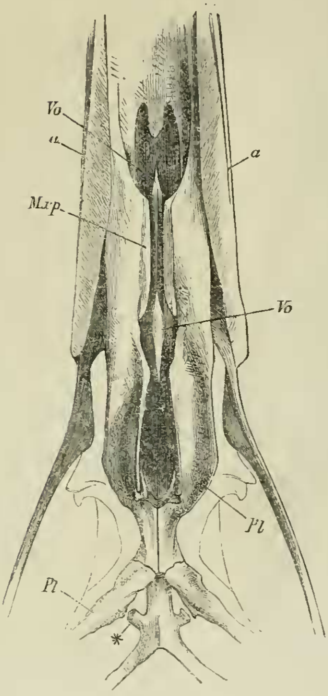
Views of the inferior aspect of the skull in *Alca torda* (fig. 10) and *Larus rissa* (fig. 11), of the size of nature. The letters have the same signification as in the figures of *Charadrius*, a comparison with which will bring out the fundamental resemblance of the three skulls better than a description can do.

But the *Procellariidæ* differ from the families which have just been enumerated in the great expansion of the maxillo-palatines, which become thick and spongy, and so closely approach the middle line that, in the Albatroses, only a very narrow cleft is left on each side of the vomer.

The front part of the vomer itself is much more strongly bent downwards than in the Gulls; and the ascending process of the palatine bone is greatly produced, and becomes anchylosed with the vomer.

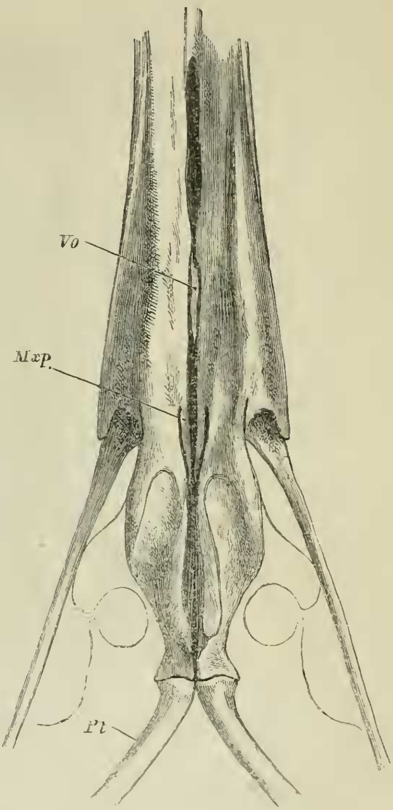
Procellaria gigas holds a sort of middle place between the Gulls and the Albatroses, the maxillo-palatines being less swollen, and the clefts between them and the vomer far larger than in *Diomedea*. In this species again the basipterygoid processes are present, though I have not been able to observe them in other *Procellariidæ*.

Fig. 12.



Procellaria gigantea.

Fig. 13.



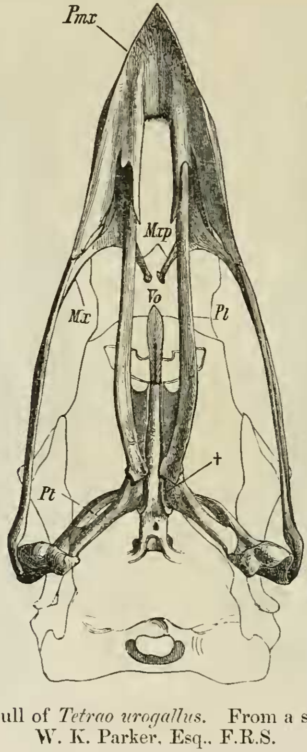
Diomedea exulans.

Under views of the skulls of *Procellaria gigantea* and *Diomedea exulans*. From specimens in the Museum of the Royal College of Surgeons. The letters as before.

Among the Gallinaceous Birds, the *Phasianidæ*, *Turnicidæ*, and *Pteroclidæ* all have basipterygoid processes, which are situated upon the rostrum, and take the form of sessile, oval, articular facets for the pterygoid bones. The palatine bones have long and slender anterior processes, and completely rounded-off postero-external angles. They have generally small, and sometimes almost obsolete, maxillo-palatines, and very imperfectly developed vomers, so that the vomero-palatine clefts are wide and, usually, almost uninterrupted, throughout their length, which is, relatively, very considerable.

The angle of the mandible is prolonged and bent upwards, sometimes, as in *Tetrao*, acquiring a prodigious length.

Fig. 14.



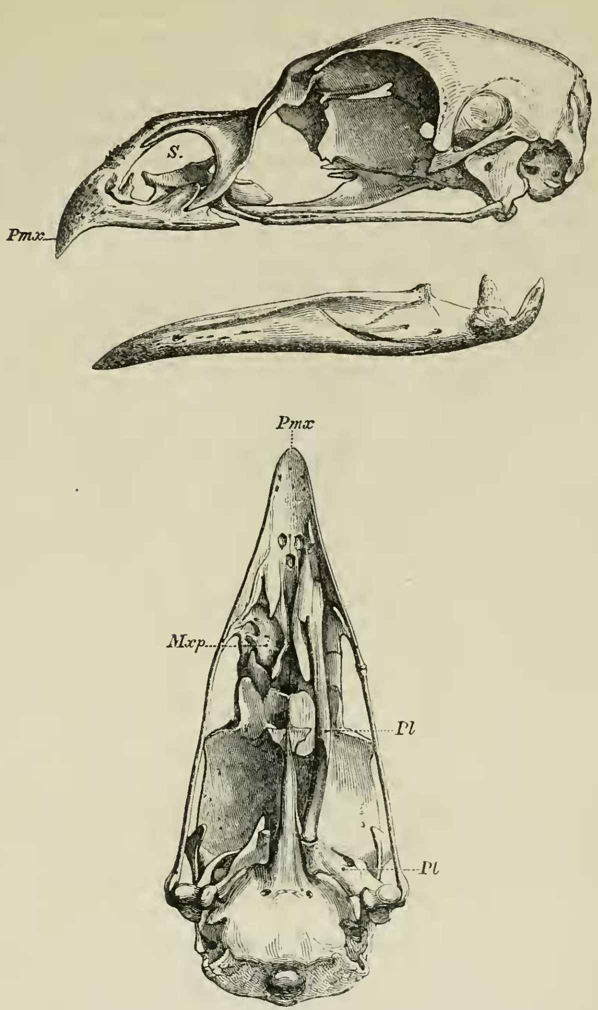
Under view of the skull of *Tetrao urogallus*. From a specimen belonging to W. K. Parker, Esq., F.R.S.

The letters as before.

In the *Megapodidæ* (e. g. *Talegalla*) the maxillo-palatines take the form of thin plates tapering to their free ends, which pass inwards and then, before they reach one another, bend back at a right angle.

The basipterygoid processes are as in the preceding genera; and the mandible has a strong recurved angular process.

Fig. 15.



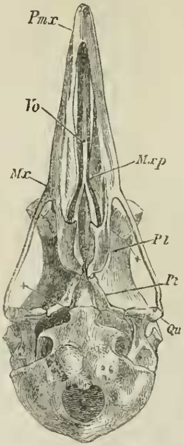
Lateral and inferior views of a skull of *Crax globicera*, in the possession of W. K. Parker, Esq., F.R.S.

In the side view *S* denotes the ossified septum. The strong recurved angular process of the mandible is well displayed; the vomer is lost, and is not represented in the inferior view; and the right palatine bone is removed to show the large maxillo-palatine plate of the maxillary (*Mxp*).

In the *Cracidæ* the characteristic basipterygoid processes, the produced and recurved angle of the mandible, and the form of the palatines remain as in the last mentioned genera. But the maxillo-palatines are large and scroll-like, stretching inwards, and in some species (e. g. *Crax globicera*) even becoming united across the middle line with one another and with a small ossification of the *septum narium*.

All *Columbidæ* (except *Didus*) have basipterygoid processes, and are completely Schizognathous. The maxillo-palatines are larger than in the ordinary Gallinaceous birds, and are elongated from before backwards, and spongy in texture, not scroll-like. The postero-external angles of the palatine bones are rounded off; but, in most of the *Columbidæ*, their inner laminæ are more prominent than the outer, instead of being obsolete as in the Gallinaceous birds. The basipterygoid processes are prominent and rather resemble those of the Plovers than those of the last-named group. Finally, the angle of the mandible is neither produced nor recurved, but is more or less abruptly truncated. The vomer is very slender.

Fig. 16.



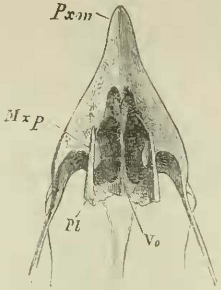
Under view of the skull of *Columba palumbus*. The letters as before.

Didus has no basipterygoid processes; but the articular end of its mandible resembles that of other *Columbidæ*.

Didunculus more nearly resembles the ordinary *Columbidæ* in possessing prominent basipterygoid processes; but the palatine bones are thick, their internal laminæ being altogether obsolete. The distal articular facet of the quadrate bone is elongated antero-posteriorly, and nearly resembles the same part in a Parrot. The axis of the fossa of the mandible which receives this facet nearly coincides with that of the ramus of the mandible; while in the other *Columbidæ* and in *Didus* it is nearly at right angles to the ramus of the mandible. The form of the angle of the mandible in *Didunculus* is quite unlike that observed in the other *Columbidæ* and in *Didus*. In these respects, therefore, *Didunculus* departs further from the ordinary *Columbidæ* than the Dodo does.

I am indebted to Mr. E. Higgins for a skin of that singular bird *Opisthocomus cristatus*, from which I was able to extract an imperfect skull, the inferior face of which is represented in fig. 17. The base of the cranium and the pterygoid bones are wanting. The underside of the unossified nasal septum supports the slender vomer (*Vo*), which expands and becomes bifurcated anteriorly, in a manner unlike anything which I am acquainted with in other birds*. The very slender anterior processes of the palatine bones (the bodies of which are almost entirely wanting in this specimen) are overlapped by the short and broad maxillo-palatines, which remain very distant from the vomer and from one another. The angle of the mandible is slightly produced and bent upwards.

Fig. 17.



Opisthocomus cristatus.
Under view of an imperfect skull. The letters as before.

These are all the birds (leaving the *Cracidæ* aside) in which I have noticed the Schizognathous disposition of the palate, which, it must be observed, is characterized not only by the complete distinctness of the maxillo-palatines from one another and from the vomer, but by the slender and usually pointed form of the latter bone.

III. Those Cuvierian Grallæ and Natatores which are not Schizognathous, the Accipitres or Raptores, the Scansores, and, among the Passeres, most of the Fissirostres, all the Syndactyli, and *Upupa* may be termed *Desmognathous*.

In these birds the vomer is often either abortive, or so small that it disappears from the skeleton. When it exists it is always slender and tapers to a point anteriorly.

---

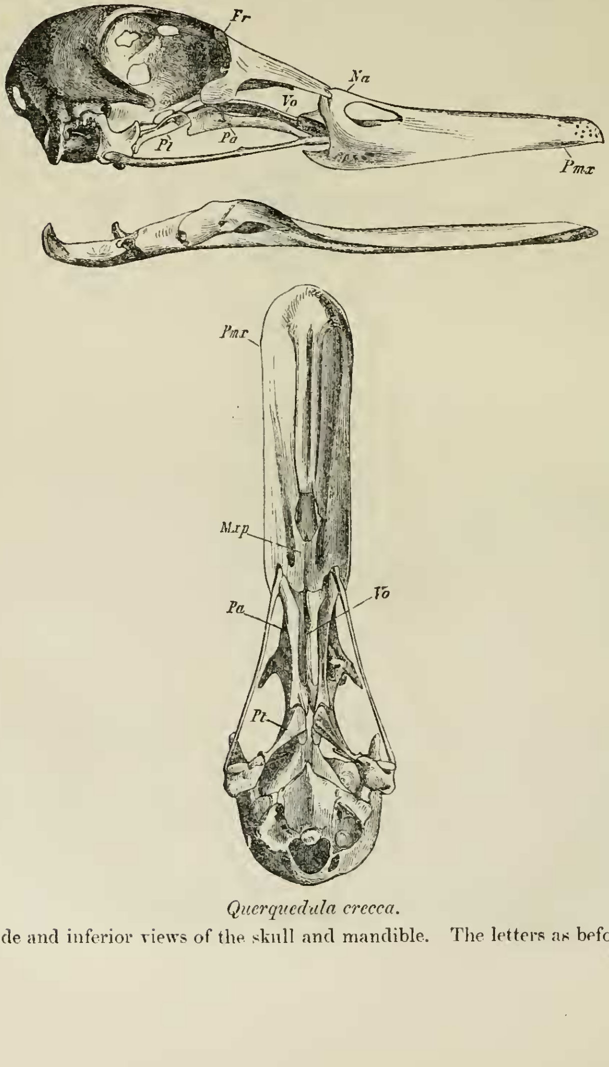
* In some of the Falcons the vomer has a nearly similar anterior termination, but its connexions are different.

The maxillo-palatines are united across the middle line, either directly or by the intermediation of ossifications in the nasal septum.

The posterior ends of the palatines and the anterior ends of the pterygoids articulate directly with the rostrum, as in the preceding division.

The desmognathous skull appears under its simplest form in *Palamedea* and the Lamellirostres. In these birds each maxillo-palatine is a broad, flat, and thin bony plate, which unites with its fellow in the middle line of the palate. The septum may be more

Fig. 18.



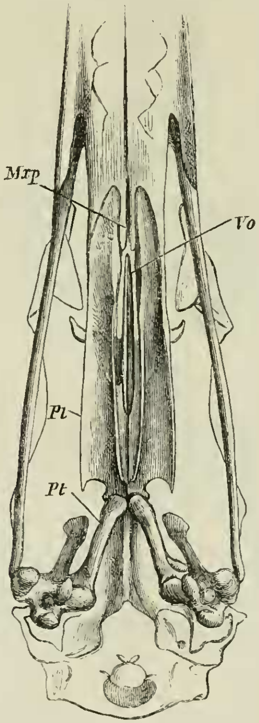
Querquedula crecca.

Side and inferior views of the skull and mandible. The letters as before.

or less ossified. The basipterygoid processes are represented by oval facets, sessile upon the rostrum, and placed so far forward that the surfaces which articulate with them are situated close to the anterior extremities of the pterygoid bones. In this respect, in the rudimentary condition of the inner lamina of the palatine bone, and in the circumstance that the angle of the mandible is strongly produced and upcurved, these resemble the Gallinaceous birds. They differ from the latter not merely by their "desmognathism" but by the absence of the rounding off of the postero-external angle of the palatine, which is so marked in the Fowls, and by the great proportional length of the region of the skull, which corresponds with the attachment of the lachrymal bone (*Fr* to *Na*, nearly, in fig. 18).

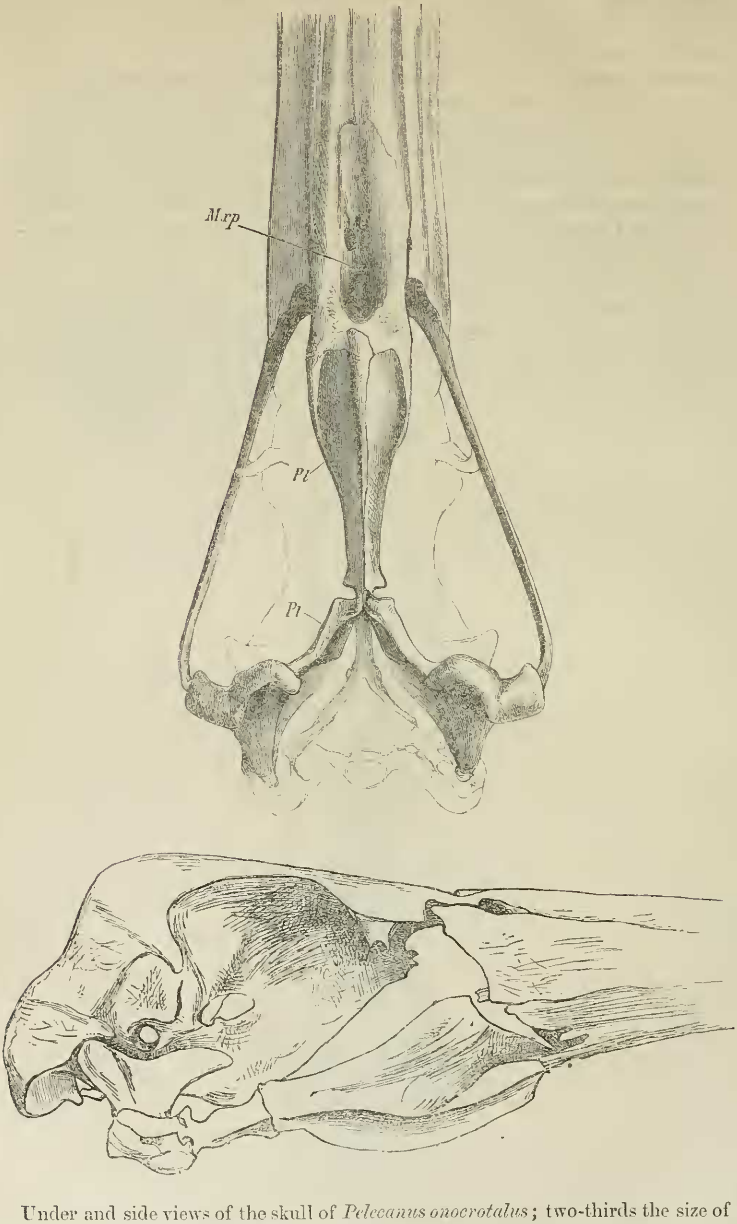
In *Ibis*, *Platalea*, and *Phœnicopterus* the maxillo-palatines not only unite across the vomero-palatine fissures, but, becoming enlarged and spongy, fill the base of the beak. The basipterygoids, rudimentary in *Phœnicopterus*, are absent in *Platalea* and *Ibis*. The angle of the mandible of *Phœnicopterus* has the same prolongation

Fig. 19.



Under view of the skull of *Ardea cinerea*. The letters as before.

Fig 20.

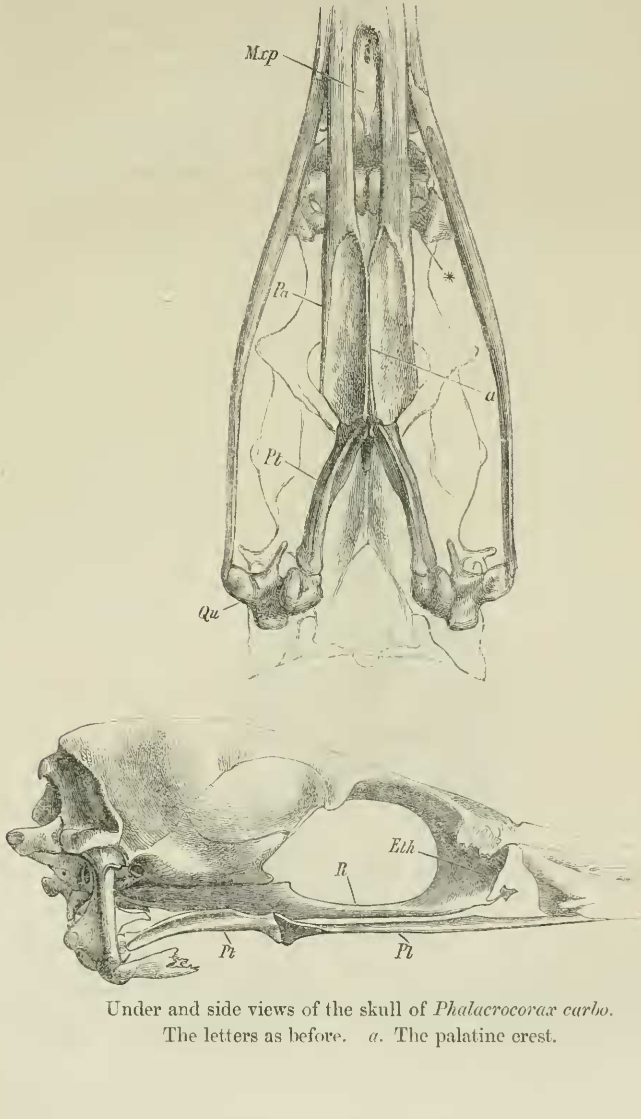


Under and side views of the skull of *Pelecanus onocrotalus*; two-thirds the size of nature. The letters as before.

and curvature as in the Lamellirostral birds; in *Platalea* and *Ibis*, while still recurved, it is much shorter and more Plover-like.

The *Ciconiidæ* and *Ardeidæ* have the maxillo-palatines disposed as in the foregoing group. There are no basipterygoids; the angle of the jaw is not prolonged and bent upwards; and the palatine bones are united for a considerable distance behind the posterior nares (fig. 19).

Fig. 21.



Under and side views of the skull of *Phalacrocorax carbo*.
The letters as before. *a*. The palatine crest.

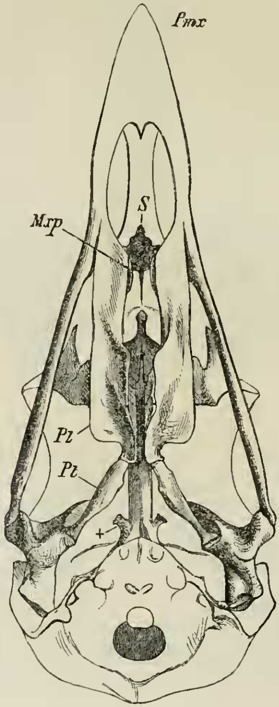
The same general arrangement is observable in the Cormorants and the Pelicans; but the inner edges of the palatine bones unite for a much greater distance behind the posterior nasal aperture, and a median ridge is sent down from the line of junction of the palatines. These birds thus present the most extreme modification of the palatine apparatus which is to be observed in the whole class.

In the *Pelecanidæ* the inferior edge of the ossified interorbital septum rises rapidly forward so as to leave a space at the base of the skull, which is filled by a triangular crest formed by the union of the greatly developed ascending processes of the palatines (fig. 20).

In the Cormorants, on the other hand, the inferior edge of the septum is horizontal, and the crest in question is not developed (fig. 21).

In all the Raptorial birds the nasal septum is ossified for a greater or less extent; and the vertical plate thus formed joins below, by

Fig. 22.



Under view of the skull of *Cathartes aura*. From a specimen in the Museum of the Royal College of Surgeons.

The letters as before. + The basipterygoid processes.

direct bony union, with the two maxillo-palatines, which are sometimes scroll-shaped, sometimes greatly swollen and spongy.

The vomer, sometimes slender, sometimes pretty broad, always tapers to a point anteriorly.

The basipterygoids sometimes are and sometimes are not present.

The angle of the mandible is not produced and recurved.

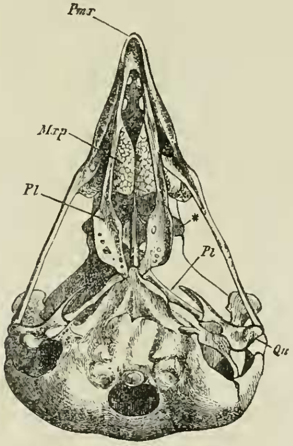
Four modifications of the general type of palatine structure are observable among the Raptorial birds:—

In the genera *Cathartes* and *Sarcorhamphus* the cleft between the thin and scroll-like maxillo-palatines is very deep and wide, and the ossification of the septum is small in extent, and only forms a sort of bridge over the deep and wide valley between the maxillo-palatines.

The basipterygoid processes are large and articulate with the pterygoids (fig. 22).

In all the Owls the maxillo-palatines are thick and spongy, and encroach upon the intermediate valley, though they never completely unite with one another across it or obliterate its upper part. The basipterygoid processes are always present (fig. 23).

Fig. 23.

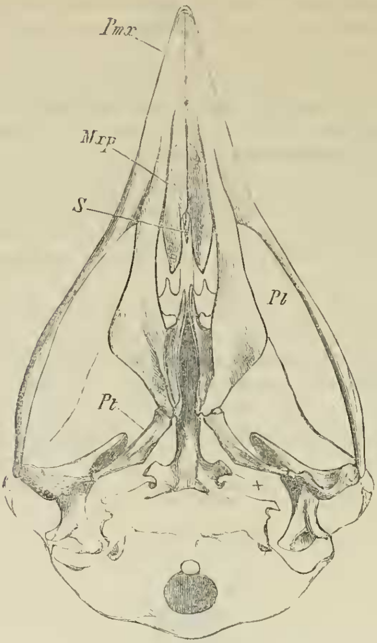


The base of the skull of *Otus vulgaris*.

The letters have the same signification as before. The inferior and internal margins of the spongy maxillo-palatines almost come into contact; but their inner faces are separated by a wide interval. * The prefrontal processes. The basipterygoid processes are not marked.

In the Secretary bird (*Gypogeranus*) the maxillo-palatines unite with one another and with the extensively ossified septum, so as to fill up the maxillo-palatine valley. There are well-developed basipterygoid processes.

Fig. 24.



Under view of the skull of *Gypogeranus serpentarius*; two-thirds the size of nature. From a specimen in the Museum of the Royal College of Surgeons.

The letters as before. + The basipterygoid processes.

In all the other Vultures, Hawks, and Eagles the maxillo-palatines unite with one another and with the largely ossified septum, and there are no basipterygoid processes.

These, therefore, are, so far as their cranial characters go, the highest of birds of prey, or those which depart most completely from the embryonic condition.

All the Parrots present wonderfully uniform cranial characters. The rostrum is articulated with the frontal bones by a complete hinge-joint. Not only is this the case, but the jugal arches and the palatine bones are moveably articulated by ligamentous joints with the rostrum. There are no basipterygoid processes.

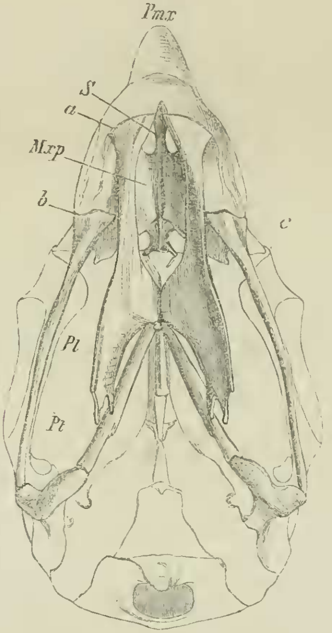
The maxillo-palatines are very large and spongy in texture, and unite with one another and with the ossified nasal septum so as to fill up almost the whole base of the beak. Above, however, a nasal passage is left on each side; and, below, the maxillo-palatines stop short, so that, in the dry skull, a passage, leading into the cavity of the rostrum, is left on each side of the septum.

The palatine bones have a highly characteristic figure, being very long, and for three-fourths of their length greatly flattened from side to side, with more or less notched, or festooned, posterior free edges.

Behind the posterior nares each palatine bone sends off a horizontal plate, which unites with its fellow for a considerable distance.

In front of this plate the palatine bones become first rounded and then flattened from above downwards, and, broadening out, articulate by transversely elongated heads with fossæ in the posterior margins of the floor of the rostrum.

Fig. 25.



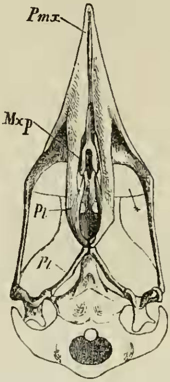
Under view of the skull of *Cacatua galerita*.

Pmx, *Mxp*, *Pl*, *Pt*, as before. *S*. The ossified septum narium. *a*. The joint between the palatine and the rostrum. *b*. That between the jugal bone and the rostrum. *c*. The joint between the rostrum and the frontal bones.

In the *Musophagidæ* (*Musophaga* and *Schizorhis*) there are no basipterygoid processes. I have not seen the vomer; so that it is probably very small and readily detached. The palatines are considerably elongated, and their posterior external regions rounded off as in the Owls, Pigeons, and *Phasianidæ*. The two spongy maxillo-palatines meet in the middle line; and in these characters, as in the form of the beak, the *Musophagidæ* present a certain resemblance to the Owls.

The only *Trogon* skull I have had the opportunity of examining is that of *T. reinwardti*. It possesses basipterygoid processes, in which respect it resembles *Caprimulgus,* and is unlike all the other genera which remain to be mentioned. The palatines have a general resemblance to those of the *Musophagidæ*. The vomer seems to be equally rudimentary; and the maxillo-palatines, though less spongy, unite in the middle line.

Fig. 26.



Under view of the skull of *Cuculus canorus*. From a specimen in the Museum of the Royal College of Surgeons.

The letters as before.

Among the *Cuculidæ, Cuculus canorus* is devoid of basipterygoids; the palatines are rounded off postero-externally; the internasal septum is well ossified and unites with the maxillo-palatines.

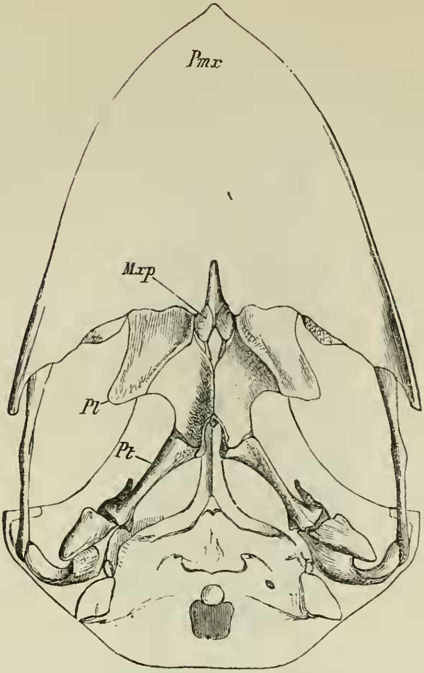
In *Geococcyx* the principle of construction is quite the same; but the postero-external angles of the palatines are distinctly indicated, and the beak is produced into an elongated triangular form. A slight oblique ridge marks off the flat surface of the maxillary process of the palatine from the excavated body of the bone. *Leptosoma* and *Phœnicophaus* present no important differences from *Geococcyx*.

In *Bucco* the general form and arrangement of the parts are as in *Geococcyx*; but the shorter palatines are produced postero-externally into a distinct backwardly directed point; the oblique ridge is much more distinctly defined, and the antero-internal angles of the palatines bend towards one another and nearly meet.

Galbula closely resembles *Bucco*; but the antero-internal angles of the palatines completely meet.

In *Rhamphastos* the only important difference from *Bucco* lies in the circumstance that the antero-internal angles of the palatines not only meet, but are united by bone, while the oblique ridge of the palatines is obsolete. The rostrum moves on the skull by a hinge, almost as freely as in the Parrots.

Fig. 27.



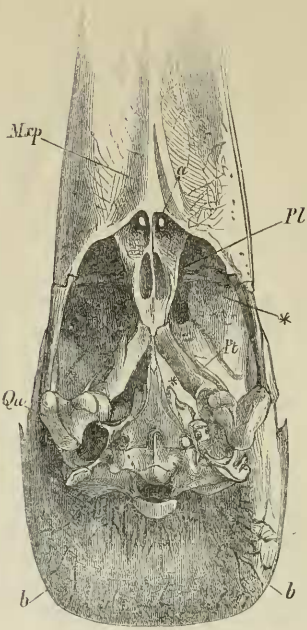
Under view of the skull of *Podargus humeralis.* From a specimen in Museum of the Royal College of Surgeons.

The letters as before.

In *Podargus* the disposition of the parts is essentially the same as in *Bucco* and *Galbula*; but the palatines are exceedingly broad, the oblique ridge in each being very distinct and often having the appearance of a suture. At its external termination the palatine is produced outwards and backwards into a strong process. The inner edges of the palatines unite for a considerable distance; and the form of the beak is completely changed, its great width giving it somewhat the appearance of an ace of spades.

Buceros, leaving aside the mere form of the beak and its frontal enlargement, resembles *Geococcyx* and *Bucco* in the structure of its palate. There are rudimentary basipterygoid processes, but the pterygoids do not articulate with them. The palatines have their postero-external angles completely rounded off and enter into solid union with one another and with the vomer, which has the form of a thin vertical lamella. The internal laminæ of the palatines incline towards one another anteriorly, and meet in front of the posterior nasal aperture, as in *Galbula* and *Rhamphastos*. Anterior to this junction again are situated two considerable apertures (*a*) divided by

Fig. 28.



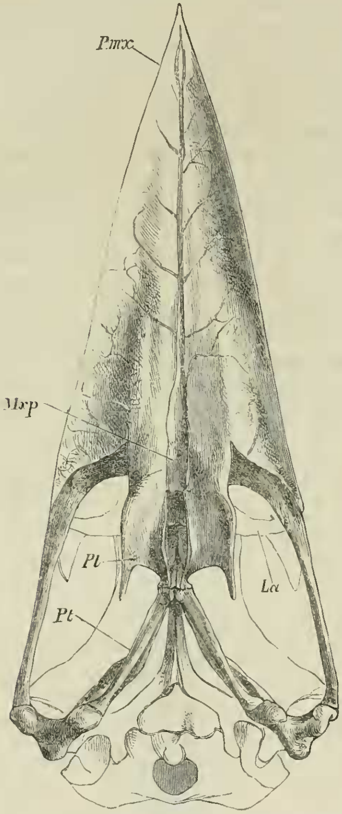
Buceros.

a. The apertures which lead into the cavity of the rostrum. *b*. The posterior part of the helmet. The other letters as before. [*N.B.* By mistake a * instead of a + is put opposite the rudimentary left basipterygoid process.]

a median septum; and these lead into the cavity which, for the most part, occupies the interior of the rostrum. I cannot say whether this septum is a prolongation of the vomer, or whether it belongs to the large and spongy maxillo-palatines, which bound the apertures in question and meet in the middle line with one another and with the vomer. In this genus the external nasal aperture is placed, as is well known, immediately in front of the anterior and upper part of the orbit. It leads into a horizontal passage, with thin, but dense, bony walls, which passes at first almost directly inwards, and then turns forwards at a right angle. The inner wall of the forwardly directed portion of the passage presents a rounded ridge, by which its cavity is imperfectly divided into an upper and a lower passage. The lower opens into the cavity of the rostrum; the upper bends back and opens into a vaulted chamber, to the roof of which a small pyriform "turbinal" is attached by its narrow end. From the inner end of this chamber a passage leads directly downwards and applies itself closely to that of the opposite side. At the level of the lower margins of the external nasal apertures the partition between the two terminates by a sharp, free, curved edge; and in the dry skull, though probably not in the recent state, the nasal chambers of the two sides freely communicate. Lower down they are separated by the vomer, and terminate in the posterior nares.

Alcedo and *Dacelo* repeat the structure observed in *Geococcyx*, with minor modifications. For example, the postero-external angles of the palatines are even more produced backwards than in *Bucco* (fig. 29).

Fig. 29.



Dacelo gigantea.

The palatine aspect of the skull. The letters have the same signification as before.

This is still more the case in *Upupa*. Here the postero-external angle of the palatine is elongated into a slender, pointed process. The septum is ossified and unites with the maxillo-palatines, which form a transverse bony rafter across the palate.

In *Merops* the long and slender palatines are devoid of any postero-external elongations. The maxillo-palatines are slender and expanded at the end, as in Passerine birds, but they unite in the middle line with one another and with the ossified septum. As the vomer was absent in the specimen examined, I presume it to have been small and slender.

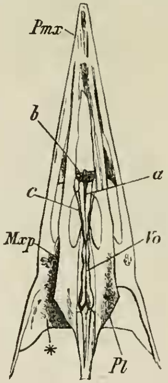
Coracias has the vomer exceedingly attenuated; and there are no basipterygoid processes. The spongy maxillo-palatines unite and form a thick transverse bar across the palate.

Eurystomus resembles *Coracias*, but has broader palatines.

It will be observed that all the genera of Birds which have been mentioned after the Parrots have their palates constructed upon the same principle as the Cuckoos. With one exception, basipterygoid processes are absent. The maxillo-palatines are united with one another, or with the ossified septum, or with both. The vomer is rudimentary, very small, and readily detached.

In *Picus viridis* there are no basipterygoid processes. Each palatine bone is flat and obliquely truncated posteriorly, the postero-external angles not being produced. An elongated oval foramen, filled by membrane in the fresh state, occupies the middle third of its inner moiety, and is bounded, in front and internally, by a very slender bar of bone (fig. 30, *c*). This bar is continuous with the palatine by its anterior end. Posteriorly, in some specimens, it appears to be continued directly into the ascending process of the palatine; but in one example I find it to terminate in a pointed end; and the slender bar which corresponds with its apparent continuation in other specimens, is a perfectly distinct ossicle (*Vo*, fig. 30).

Fig. 30.



The palate of *Picus viridis*.

a. The ossified septum. *b*. The transverse bar of bone connected with it. *Vo*. The ossicles which probably represent the vomers. *Pmx*, *Mxp*, *Pl*, *, as before.

I am disposed to regard this ossicle and its fellow as the representatives of the vomers, which, if this interpretation be correct, remain exceptionally distinct from one another, but unite with the palatines. The antero-internal angle of the body of the palatine bone sends forwards a slender process, which forms the inner boundary of the posterior half of the palatine foramen.

The maxillo-palatines are broad plates, which appear to terminate by rounded internal edges close to and above the external margins of the palatines. But a tough membrane extends inwards from the free edge of each maxillo-palatine and meets with a delicate longitudinal ossification of the septum (*a*, fig. 30). Opposite the anterior termination of the external nasal aperture this ossification is connected with a transverse bar of bone, which stretches from one præmaxilla to the other, and shuts off the cavity enclosed by the præmaxillæ from the nasal chambers. The latter are greatly complicated by the development of twisted "turbinal" plates in connexion with the nasal and premaxillary bones and the ethmoid.

A prolonged and careful study of fresh specimens will be necessary before the arrangement of the parts in *Picus* can be thoroughly understood. In the meanwhile it is clear that, in this genus, the palate differs very widely from that observed in any of the preceding "cuculiform" genera.

In *Picus major* the palatine bones have the same structure and arrangement as in *P. viridis*, except that their posterior ends are transversely truncated and the postero-external angles are even a little produced. The maxillo-palatines are much smaller than in the preceding species, and their inner rounded edges do not nearly reach the level of the outer edges of the palatines.

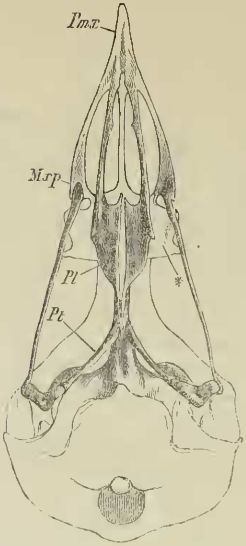
Picus canus resembles the preceding; but the postero-external angles of the palatines are rather better marked, and the maxillo-palatines a little larger.

Picus medius presents no difference of importance, except that the inner laminæ of the palatines, obsolete in the other genera, are a little better marked, especially behind.

In *Picus minor* distinct maxillo-palatines can hardly be said to be present, the maxillary presenting only a slight dilatation at the point where they should exist. Minute points of bone projecting from the inner edges of the palatines alone indicate the position of the process (*c*) in *Picus viridis* and of the prolongation of the antero-internal angle of the body of the palatine. The "oval foramen" consequently is indicated only by a slight excavation of the inner margin of the palatine.

This species of *Picus* prepares one in some degree for the structure observed in *Yunx* (fig. 31). Here the ascending processes of the palatine bones are produced forwards into long and slender processes, slightly swollen at their anterior free ends, which may represent anchylosed vomers. The inner edges of the short and broad bodies of the palatine bones approach so nearly as only to leave a cleft for the posterior nares. The antero-internal angles are acute, but not greatly prolonged. The anterior processes of the palatines are very

Fig. 31.



View of the palate of *Yunx torquilla* (× 2). The letters as before.

slender, and the inner edge of each is angulated near its anterior termination. This angulation may represent the process *c* (fig. 30) in *Picus viridis*. The maxillo-palatines are represented by mere ridges on the inner side of the maxillæ, bounding a fossa. No ossification of the septum remains in any of the skulls of *Yunx* I have examined.

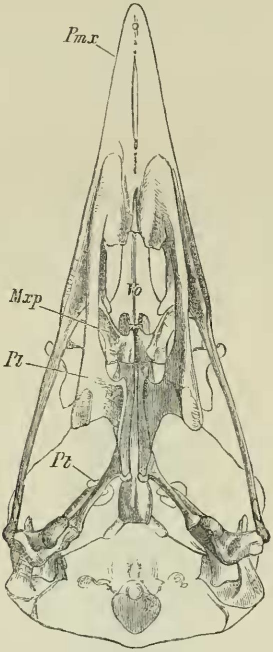
I have discussed *Picus* and *Yunx,* in this place, because of the general agreement among ornithologists that *Picus* and its allies are closely related to the Cuckoos and other "Scansores." But it is clear that nothing can be more different than the cranial structure of the *Picidæ* and that of any of the other "*Scansores*;" and, indeed, judging from the dry skull alone, the Woodpeckers are not even desmognathous. But, as I have already hinted, a question of this systematic importance cannot be finally settled without the careful investigation of fresh specimens.

IV. The remaining Carinatæ have a palatine structure which is in some respects intermediate between that of the Schizognathous and that of the Desmognathous groups, while in others it is peculiar.

This structure, which I term Ægithognathous, is well exemplified by any of the typical Passerine Birds, as, for example, a Raven (fig. 32).

The vomer is a broad bone, abruptly truncated in front, and deeply cleft behind, embracing the rostrum of the sphenoid between its forks. The palatines have produced postero-external angles. The maxillo-palatines are slender at their origin, and extend inwards and backwards obliquely over the palatines, ending beneath the vomer in expanded extremities, which do not become united by bone, either with one another or with the vomer. The anterior part of the nasal septum (in front of the vomer) is frequently ossified in Ægithognathous birds, and the interval between it and the præmaxilla filled up with spongy bone; but no union takes place between this ossification and the vomer.

Fig. 32.



Under view of the skull of *Corvus corax*. The letters as before.

This structure (which was first accurately described and its systematic importance pointed out by Nitzsch*) is substantially repeated in the great majority of Passerine birds, though with minor modifications, which I suspect will turn out to be characteristic of the natural subdivisions of this great group. At present I can only mention two or three of these.

Menura differs from all the rest in possessing no ossified maxillo-palatines whatever. The vomer, though broad and deeply cleft posteriorly, is more rounded off than abruptly truncated at its anterior end.

---

* See the article "Passerinæ" in Ersch and Grüber's 'Encyclopædie,' 1840, and Nitzsch, "Ueber die Familie der Passerinen," in the 'Zeitschrift für die gesammten Naturwissenschaften,' 1862.

In *Tyrannus*, in *Cephalopterus*, in *Coracina* (according to Burmeister), and perhaps in others of the American Passerines without a singing-apparatus, the bases of the maxillo-palatines are broader than their free ends, and there is no narrow stem.

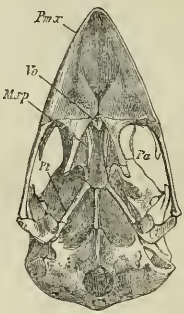
Chasmorhynchus nudicollis, however, has maxillo-palatines of the ordinary character; and in *Pteroptochus megapodius* they are long, slender, and recurved.

In *Gymnorhina* the septo-premaxillary ossification and the maxillo-palatines are confluent, though the latter and the vomer remain quite distinct from one another.

In these and the majority of typical Passerine birds the palatine bones are broad and comparatively flat posteriorly; but in the Finches the outer lamina of each palatine acquires a great downward development, and becomes a vertical plate, the free posterior edge of which is more or less notched. The anterior process of the palatine at the same time broadens out, and becomes connected by a truncated edge with the rostrum, which attains great height and breadth, and is sometimes hooked anteriorly.

The palate thus acquires a singular superficial resemblance to that of a Parrot, from which it differs, however, in the separation of the palatines in the middle line, in the form and size of the vomer, and in the slender, recurved, and separate maxillo-palatines (fig. 33).

Fig. 33.



Under view of the skull of *Coccothraustes vulgaris*. The letters as before.

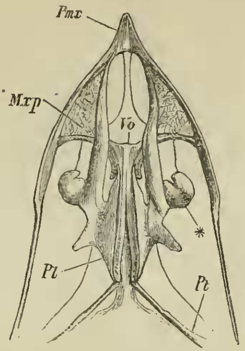
Pipra erythrocephala and *Tanagra cyanoptera* are similar to the Finches in the form of the palatines.

The Swallows completely agree with the other Passerine birds in the general form and arrangement of the bones which enter into the composition of their palates.

And the Swifts essentially resemble the Swallows, though the form and proportions of the palatine bones are somewhat different (fig. 34).

The skull of *Caprimulgus*, though it retains the general features of the Passerine cranium, departs from the typical Passerine structure still further than the Swifts, the body of the palatines having become exceedingly broad and flattened out, while the vomer is

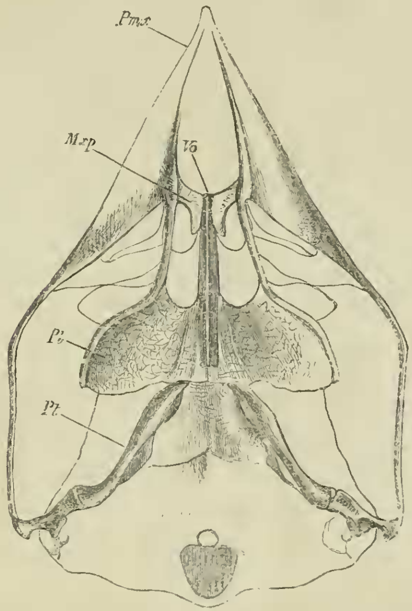
Fig. 34.



The palate of *Cypselus apus* (× 2).

The anterior excavated end of the vomer has a crescentic shape, its angles terminating in free horns above the palatine bones, by which they are concealed in the figure. The inferior ends of the prefrontal processes (*) have a very peculiar form.

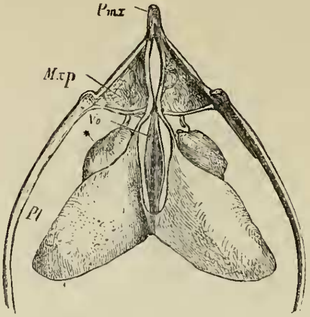
Fig. 35.



Under view of the skull of *Caprimulgus europæus* (× 2).

The letters as before.

Fig. 36.



Nyctibius jamaicensis.
View of the palate without the pterygoid bones. The letters as before.

longer and narrower than in the Swifts or the typical Passerine birds.. The expanded inner ends of the slender and characteristically Passerine maxillo-palatines are quite distinct from the vomer and from one another.

Caprimulgus further presents a remarkable contrast to the Swifts and all the true Passeres in having well-developed basipterygoid processes. These are absent in *Ægotheles novæ-hollandiæ,* the palate of which is intermediate between that of the Goatsuckers and that of the Swifts.

Nyctibius closely resembles *Caprimulgus,* even to possessing the very peculiar division of each ramus of the mandible into two portions, the one of which is moveable upon the other, pointed out in the latter genus by Nitzsch. But the slender anterior processes of the palatines are closely approximated in the middle line, instead of remaining widely separated as in *Caprimulgus* and *Trochilus*; and the maxillo-palatines are closely adherent to them and to the vomer, though a true anchylosis does not appear to have taken place.

Trochilus has the true Passerine vomer, with its broad and truncated anterior, and deeply cleft posterior end. I have not yet been able to obtain a perfectly satisfactory view of the structure and arrangement of the palatine bones in the Humming Birds.

That the birds of which I have spoken under the four heads of *Dromæognathous, Schizognathous, Desmognathous,* and *Ægithognathous* really possess the various arrangements of the palatine and adjacent bones which I have described, is a matter of observation which readily admits of confirmation or the reverse. It is another and very important question whether these cranial characters may safely be taken as indications of natural affinities; and I now propose to make a few remarks on that point.

It will not, I think, be disputed by any ornithologist that the *Schizognathous* birds constitute a very natural assemblage. Taking the Plovers and their allies as the most central group of these birds, we may pass, without a break of more than family importance, along several distinct series, or gradations, of ornithic forms.

Thus, along one line, the Bustards are intermediate between the Plovers and the Cranes; while *Psophia* and *Rhinochetus* lead from the Cranes to the Rails.

Following another line, *Hemipodius* stands between the Plovers and the Fowls; while *Syrrhaptes* inclines, on the one hand, to the typical Gallinaceous birds, and on the other to the *Columbidæ.*

A third series is commenced by the Gulls. The osteological resemblances between a Plover, a Gull, an Auk, and a Diver are so close that it is utterly out of the question to regard these Birds as members of different orders. But the Gulls grade insensibly into the *Procellariidæ*; and, though the *Apterodytidæ* appear to be separated by a broad gap from the *Alcidæ, Alca impennis*, in the form of its humerus, in the mode of articulation of the radius and ulna with the humerus, in the proportions and structure of the tarso-metatarsal bone, shows itself to be an almost intermediate form.

I am acquainted with only two birds, *Dicholophus* and *Crax globicera*, the structure of the skull of which would lead me to regard them as transitional between the Schizognathous and the Desmognathous sections, or, at any rate, as approaching the latter division.

Nitzsch and Burmeister have assigned to *Dicholophus* a position near the Cranes and the Rails, and, no doubt, justly on the whole, though I venture to think that they have underrated the points of resemblance to the birds of prey, and especially to *Gypogeranus*. In the skull of *Dicholophus* the internasal septum is ossified to a very slight extent, and the maxillo-palatine processes may meet in the middle line, in both of which respects it approaches the birds of prey. But the ossified part of the nasal septum does not unite below with the maxillo-palatines; and in this respect *Dicholophus* is unlike the Raptorial birds*.

Crax globicera, on the other hand, while it retains the characteristically Gallinaceous basipterygoid articular surfaces, palatine bones, angle of the mandible, and other peculiarities, has a partially ossified nasal septum, which divides below and unites with the maxillo-palatines, just as in the Raptorial birds.

The *Cuculidæ* and *Alcedinidæ* occupy nearly the same middle place in the Desmognathous series that the Plovers have among the Schizognathous families. The *Musophagidæ* bring them into relation with the Raptorial birds, the *Rhamphastidæ* with the Parrots, the *Podargidæ* with *Cancroma*†, and so with the Herons and Storks. But these last are clearly affined, on the one hand, with the Cormorants and Pelicans, on the other with the Flamingos, and through the latter with the Lamellirostres.

---

* Mr. Parker is inclined to lay a still greater stress than I have done upon the many Raptorial characters of *Dicholophus*.

† A hazardous suggestion, but one the temerity of which will perhaps appear less after a careful comparison of the skulls of these two birds.

It is unnecessary to enumerate the arguments by which the close affinity of the proper Passerine birds (which make up the great bulk of the Ægithognathous section) may be demonstrated, as the eminently natural character of this group is admitted by every one.

In their cranial characters, the Swifts are far more closely allied with the Swallows than with any of the Desmognathous birds, the Swift presenting but a very slight modification of the true Passerine type exhibited by the Swallow. No distinction can be based upon the proportions of the regions of the fore limb; since in all the Swallows which I have examined[*] the manus and the antebrachium, respectively, greatly exceed the humerus in length, though the excess is not so great as in *Cypselus*.

The modification commenced in the Swift is greatly exaggerated in *Ægotheles* and *Caprimulgus*; while we have almost a transition to the Desmognathous structure in *Nyctibius*.

But if palatine characters have the taxonomic value which the facts just enumerated appear to indicate, it follows that the *Dromæognathous* structure, so different from what is to be seen in any other Carinate birds, has as much value as the rest, notwithstanding the small actual extent of the group in which it obtains.

It thus appears that the Dromæognathous, Schizognathous, Desmognathous, and Ægithognathous arrangements of the maxillary and palatine bones, respectively, characterize divisions of the Carinatæ, all the members of which are mutually affined in other respects. And I propose to regard these divisions as suborders, and to name them DROMÆOGNATHÆ, SCHIZOGNATHÆ, DESMOGNATHÆ, and ÆGITHOGNATHÆ[†].

The suborder DROMÆOGNATHÆ, containing only one family, the *Tinamidæ*, admits of no subdivision into groups of larger extent than families; but the other three suborders are very extensive, and, I think, may be so subdivided in an approximately satisfactory manner, though any definition of these subdivisions which can be proposed at present must be regarded as provisional and open to extensive revision as our knowledge of the details of ornithic organization widens.

The SCHIZOGNATHÆ. In addition to their cranial characters, the birds composing this suborder often want intrinsic muscles in the lower larynx, and never possess more than one pair of them.

With the exception of *Podiceps*, all the genera which have been examined have two carotid arteries.

Six groups of allied families are distinguishable in this suborder. These may be termed the CHARADRIOMORPHÆ, the GERANOMORPHÆ, the CECOMORPHÆ, the SPHENISCOMORPHÆ, the ALECTOROMORPHÆ, and the PERISTEROMORPHÆ[‡].

---

[*] *Hirundo pacifica*, *H. riparia*, *H. rustica*, *H. urbica*.

[†] *Dromæus*, the generic name for the cassowaries; *σχίζω*, to cleave; *δεσμὸς*, a bond; *Αἴγιθος*, a sparrow.

[‡] *Χαραδριὸς*, a sea-lark, or plover; *Γέρανος*, a crane; Κὴξ, a gull; *Spheniscus*, a genus of penguins; *'Αλέκτωρ*, a cock; *Περιστερὰ*, a dove; *μορφὴ*, form.

† 1. The Charadriomorphæ.

The rostrum is always elongated and comparatively slender. The base of the skull possesses narrow and prominent basipterygoid processes. The maxillo-palatines are concavo-convex and lamellar, never swollen or spongy. The angle of the mandible is produced into a slender and abruptly recurved process.

The sternum is sometimes singly, but, more usually, doubly notched.

The hallux, always small, is sometimes absent.

The phalanges of the anterior toes diminish in length from the basal to the penultimate.

The pterylosis of this group, which nearly corresponds with the pressirostral and longirostral Grallæ of Cuvier and with the *Limicolæ* and *Scolopacinæ* of Nitzsch, has been carefully described by the latter writer, who remarks that, "next to the *Passerinæ* and *Gallinaceæ*, this group appears to present the smallest pterylographic differences" *, and that in the form of the tracts it closely approaches *Psophia* and *Grus*.

The feathers always cease above the suffrago, though sometimes the bare area is very small; and the webs between the front toes are large only in *Recurvirostra*.

† 2. The Geranomorphæ.

The rostrum is relatively stronger than in the preceding group, and may even be short and arched.

Basipterygoid processes are absent (ex. *Grus antigone*).

The maxillo-palatines are concavo-convex and lamellar.

The angle of the mandible is truncated.

In the typical groups the sternum is comparatively narrow and elongated, and may be deeply notched or entire.

The feet vary greatly, but the toes are never completely or even extensively webbed; and the ratio of the length of the phalanges of the toes is as in the preceding division.

A greater or less space above the suffrago is devoid of feathers; but there appears to be nothing characteristic about the pterylosis of this group.

I consider the Cranes and the Rails (between which *Psophia* and *Rhinochetus* are intermediate) the typical forms of this group.

Otis connects it with the Charadriomorphæ, and *Dicholophus* with the birds of prey; but it is a question whether these two genera may be better included in this group, or made types of separate groups.

† 3. The Cecomorphæ.

The rostrum varies greatly in shape; but is very generally compressed from side to side, and hooked at the extremity.

Procellaria gigantea alone has presented basipterygoid processes.

The maxillo-palatines are usually lamellar and concavo-convex as in the preceding groups; but in the *Procellariidæ* they become tumid and spongy, and may enlarge so much as to leave a mere cleft in the place of each vomero-palatine space.

---

* See Nitzsch, 'Pterylography' (Ray Society's Edition), p. 134.

The angle of the mandible is not recurved.

The sternum varies extensively.

The hallux is weak, or absent, and (with the exception of the Grebes) the anterior toes are completely, or very largely, webbed. The ratio of the phalanges is as in the preceding groups.

This group contains the *Laridæ* (*Longipennes*, Nitzsch), the *Procellariidæ*, the *Colymbidæ*, and the *Alcidæ*. Nitzsch (*l. c.*) remarks that the pterylosis of the first-named family "approaches very closely to that of the Scolopacinæ, and can hardly be distinguished therefrom by any character;" and the same may be said of the osteological and other peculiarities of the *Laridæ*, which come very near the Charadriomorphæ. The *Alcidæ*, on the other hand, in their pterylosis and other characters approach the Penguins—especially, as has been noted above, through *Alca impennis*. The *Colymbidæ* appear to be closely connected on the one hand with the Gulls, and on the other, more remotely, but still really, with the Rails.

The *Procellariidæ* are aberrant forms inclining towards the Cormorants and Pelicans among the Desmognathæ.

+ 4. The Spheniscomorphæ.

The beak is straight and compressed, the rostrum being, at most, slightly hooked at the tip.

There are no basipterygoid processes, and the pterygoids are flattened from above downwards.

The maxillo-palatines are concavo-convex and lamellar.

The sternum is greatly elongated.

The shaft of the humerus is flattened from side to side, and its distal end presents an obliquely truncated surface, with which the similarly compressed radius and ulna articulate—the former altogether with the fore part, the latter with the hinder part of the humeral articular surface.

There is no free pollex.

The pelvic bones are less firmly connected with the sacrum than in any other birds.

The short tarso-metatarsus is perforated by two very large clefts which lie between the middle and the lateral metatarsals. The small hallux is directed inwards or forwards. The ratio of the phalanges is as in the preceding groups.

The anterior toes are completely webbed.

This group answers to the Squamipennes of many authors, and contains the single family *Apterodytidæ*, comprising the genera *Eudyptes*, *Spheniscus*, and *Apterodytes*.

Nitzsch has pointed out that these birds have no remiges distinct from the other feathers, which are distributed evenly over the whole body, and, though small and scale-like, are provided with an aftershaft.

+ 5. The Alectoromorphæ.

The rostrum may be slender and depressed, or high and arched. Oval, flattened basipterygoid facets, sessile upon the basisphenoidal rostrum and articulating with corresponding surfaces upon the pterygoids, are always present. The maxillo-palatines are always lamellar, but vary greatly in size, being sometimes very small.

The palatine bones are relatively long and narrow, with obsolete internal laminæ, and rounded-off postero-external angles.

The angle of the mandible is produced into a strong upcurved process.

The sternum has either one or more, generally two, very deep posterior notches on each side; when there are two, the external lateral processes thus marked out are much shorter than the internal.

The feet vary considerably in the relative size and in the position of the hallux, and in the development of spurs. They are never completely, or even largely, webbed. The ratio of the phalanges of the front toes is as in the preceding groups.

According to Nitzsch the feathers have aftershafts, and the pterylosis is remarkably uniform in all the genera except the *Pteroclidæ*, a family which, in this and some other respects, but not in cranial characters, approaches the Pigeons.

Except in *Pterocles*, the oil-gland is surmounted by a circlet of feathers.

The inferior larynx is always devoid of intrinsic muscles.

Excluding the Pigeons and the *Tinamidæ*, this group corresponds with the Gallinæ of authors, and contains the families *Turnicidæ*, *Phasianidæ*, *Pteroclidæ*, *Megapodidæ*, and *Cracidæ*.

The *Turnicidæ* approach the Charadriomorphæ, the *Pteroclidæ* the Peristeromorphæ; while the *Cracidæ* have relations with the birds of prey on the one hand, and with *Palamedea* and the other Chenomorphæ on the other.

+ 6. The Peristeromorphæ.

The rostrum is swollen at the tip, and provided at the base with a tumid membranous space, in which the nostrils open.

The skull is provided with narrow, but prominent, basipterygoid facets.

The maxillo-palatines are elongated and spongy.

The angle of the mandible is not produced and recurved.

The sternum has two posterior notches, the inner pair of which may be converted into foramina. The external lateral processes thus formed are, as in the Alectoromorphæ, much shorter than the internal lateral processes.

The hallux is on a level with the rest of the toes, and its metatarsal is peculiarly twisted. The anterior toes are not at all webbed. The ratio of the phalanges is as in the preceding groups.

The feathers have no aftershaft (? *Didus*), and the oil-gland is devoid of a circlet of feathers.

The inferior larynx is provided with a single pair of intrinsic muscles (? *Didus*).

The relations of the Peristeromorphæ with the Alectoromorphæ are very close. On the other side they seem to be allied with the Owls and the Vultures.

I have not been able to examine, for myself, more than an incomplete skull and the feet of *Opisthocomus*. The phalanges of the anterior toes (leaving the ungual phalanges out of consideration) are nearly equal in length. The tarso-metatarse is similar to that of the Alectoromorphæ. But the extraordinary sternum, furcula, and the many other peculiarities of this bird described by L'Herminier, Deville, and Gervais lead me to think that it must be placed in a special subdivision of the Schizognathæ.

The DESMOGNATHÆ, like the Schizognathæ, may be without intrinsic muscles of the lower larynx, or they may possess only one pair, or they may have three pairs; but the lower larynx is never constructed on the plan of that of the song-birds.

The carotids may be double or single.

Not fewer than seven groups of families appear to me to be clearly distinguishable in this suborder, viz. the CHENOMORPHÆ, the AMPHIMORPHÆ, the PELARGOMORPHÆ, the DYSPOROMORPHÆ, the AETOMORPHÆ, the PSITTACOMORPHÆ, and the COCCYGOMORPHÆ. In addition to these undoubted Desmognathæ I shall at the end of this series consider the Woodpeckers under the name of CELEOMORPHÆ*.

1. The CHENOMORPHÆ.

The lachrymal region of the skull is remarkably long.

The basisphenoidal rostrum has oval, sessile, basipterygoid facets, like those of the Alectoromorphæ.

The flat and lamellar maxillo-palatines unite and form a bridge across the palate.

The angle of the mandible is greatly produced and recurved.

The sternum has a single pair of notches at its truncated posterior margin.

The feet generally have a short hallux, and the anterior toes are completely webbed; but *Palamedea* and *Anseranas* are remarkable exceptions to this rule. The phalanges of the anterior toes decrease in length from the basal to the penultimate.

The oil-gland is surmounted by a circlet of feathers, and the larynx has no intrinsic muscles (? *Palamedea*).

2. The AMPHIMORPHÆ.

The genus *Phœnicopterus* is so completely intermediate between the Anserine birds on the one side, and the Storks and Herons on the other, that it can be ranged with neither of these groups, but must stand as the type of a division by itself.

---

* Χὴν, a goose; ἀμφὶ, on both sides; Πελαργὸς, a stork; *Dysporus*, a generic name applied to the gannets by Illiger; 'Αετὸς, an eagle; Ψίττακος, a parrot; Κόκκυξ, a cuckoo; Κέλεος, a woodpecker.

Thus the skull has the long lachrymo-nasal region, the basipterygoid facets, the prolonged and recurved angle of the mandibles, the laminated horny sheath of the Chenomorphæ; but the maxillo-palatines are spongy, and the general structure of the rostrum is quite similar to that found in the Storks and Herons.

The lower end of the crus is bare; but the feet are fully webbed, and the pterylosis is said by Nitzsch to be "completely Stork-like."

+3. The Pelargomorphæ.

There are no basipterygoid processes, and the palatines usually unite for a greater or less distance behind the posterior nares; but they send down no vertical plate from their junction.

The maxillo-palatines are large and spongy.

The angle of the mandible is truncated (except in *Platalea* and *Ibis*).

The sternum is broad, and may have two or four posterior notches.

The hallux varies in its proportions, but is not turned forwards or inwards, or united by a web with the other toes, the web between which is always incomplete. The ratio of the phalanges is as in the preceding groups.

The oil-gland is surmounted by a circlet.

The disposition of the carotids and the characters of the larynx vary.

I associate in this division the *Herodiæ*, *Pelargi*, and *Hemiglottides* of Nitzsch. The last group, including the genera *Ibis* and *Platalea*, differs from the rest in having a produced and recurved mandibular angle, and in some other respects approaches *Phœnicopterus*. The typical forms incline rather to the succeeding group.

+4. The Dysporomorphæ.

The rostrum is long and pointed and more or less curved, and the external nasal apertures are very small. There are no basipterygoid processes. The palate-bones unite for a considerable distance behind the posterior nares, and send down a vertical crest from their junction.

The maxillo-palatines are large and spongy.

The angle of the mandible is truncated.

The sternum is broad, and its truncated posterior edge is either entire or has a shallow excavation on each side of the middle line.

The hallux is turned forwards or inwards, and is united by a web with the completely webbed anterior toes. The ratio of the phalanges is as in the preceding genera.

The oil-gland is surmounted by a circlet of feathers.

This group answers to the "Steganopodes" of Illiger; and since the appearance of the admirable memoir of Brandt, 'Zur Ostéologie der Vögel,' in 1840, no doubt can have been entertained as to its extremely natural characters. The genera composing it are sharply divided by the structure of the skull, described above, into two groups —the one containing the Pelicans, the other the remaining genera.

5. The AETOMORPHÆ.

The rostrum is more or less arched and hooked at the tip, and at its base there is a cere in which the nostrils are pierced. Basipterygoid processes may be present or absent. The maxillo-palatine processes may be concavo-convex lamellæ, or may be spongy and fill up the base of the rostrum, but they are always united with an ossification of the septum.

The breadth of the articular surface at the distal end of the quadrate bone is greater than its length, the outer condyle extending about as far downwards as the inner.

The angle of the mandible is never recurved.

The sternum is broad, and has a strong carina. Its posterior edge may be entire, or may have one or two notches on each side.

The pelvis and the tarso-metatarsus vary greatly. The feet always possess a hallux; the fourth toe is never permanently turned backwards, and the anterior toes are never completely or even largely webbed. In other respects they vary.

There are always two carotids.

The inferior larynx may be wanting, and when developed has not more than one pair of intrinsic muscles.

The circlet of feathers may be present or absent upon the oil-gland; and the contour feathers have, or have not, an aftershaft.

The division of the Aetomorphæ is equivalent to the "Raptores" of Cuvier—an eminently natural assemblage, and yet one the members of which, as the preceding enumeration of their characters shows, vary in most important particulars.

They appear to me to fall naturally into four well-defined primary groups—the *Strigidæ*, the *Cathartidæ*, the *Gypaetidæ*, and the *Gypogeranidæ*. But this arrangement is so different from that ordinarily adopted, that I shall proceed to justify it by enumerating the principal circumstances in which the members of the several divisions agree with one another and differ from the rest.

In the *Strigidæ*, or Owls, the feathers want the aftershaft, and the oil-gland is not surmounted by a circlet of feathers. The hallux is more than half as long as the fourth toe, and on a level with the other toes. The claws are long, curved, and acute, and the fourth toe is reversible.

The first three phalanges of this toe are subequal and very short; all three together are not so long as the penultimate phalanx.

The basal phalanx of the third toe is not longer than the second, and is far shorter than the penultimate.

The tarso-metatarsus is extremely flattened, with strong lateral ridges, the inner edge being particularly thin; and, usually, there is an osseous loop for the extensor tendons on its front face.

The posterior face of the proximal end of the tarso-metatarsus presents two ridges (of which the inner is very much stronger and more prominent than the almost obsolete outer) separated by a deep and wide groove.

The skull is broad, and the bones of the brain-case have a spongy diploë. Basipterygoid processes are always present, and the tumid and spongy maxillo-palatines are separated by an interval, which may be wide throughout, or reduced to a cleft below.

The peculiarly spongy lachrymal remains distinct for a long time, if not throughout life, from the frontal bones and the prefrontal processes.

The external nares may be long, but are never pervious, the septum being well ossified.

The sternum is commonly four-notched, and has a manubrial process.

The proximal ends of the clavicles are comparatively little expanded or recurved, and become very slender towards their symphysis. The clavicular process of the coracoid fits into an excavation on the outer surface of the clavicle. The scapular process of the coracoid is prolonged forwards to meet the clavicle. The lower larynx possesses one pair of intrinsic muscles.

The *Cathartidæ* comprise the Vultures of the New World (*Cathartes* and *Sarcoramphus*)*. The feathers have no aftershaft, and the oil-gland wants the circlet of feathers. The phalanges of the hallux, taken together, are about half as long as those of the outer toe, and the articular surface of its short metatarsal lies above the level of the articular faces of the other metatarsals; the claws are blunt and comparatively straight, and the fourth toe is not reversible.

The second and third phalanges of the fourth toe, taken together, are as long as, or longer than, the basal phalanx.

The basal phalanx of the third toe is longer than either the second or the penultimate, the two latter being subequal.

The tarso-metatarsus is thick, and its inner edge rounded and not much thinner than the other.

The posterior face of the proximal end of the bone presents a broad and prominent process, with a truncated posterior surface. This surface has the contour of a heart with its apex downwards, and is divided by a low longitudinal ridge into two slightly excavated surfaces, of which the outer is the smaller. Below, the process passes into a ridge, which runs down upon the middle metatarsal.

The skull is provided with basipterygoid processes, and has an elongated rostrum. The valley between the lamellar maxillo-palatines is both deep and wide.

The lachrymal bones are so completely anchylosed with the frontals and with the broad prefrontal processes, that all traces of their primitive distinctness are completely lost.

* I have examined skeletons of *Cathartes fœtens*, *C. aura*, and *C. californianus*, of *Sarcorhamphus gryphus* and *S. papa*, and compared them with species of *Neophron*, *Vultur*, *Gyps*, *Gypohierax*, and *Gypaetus*.

The external nares are extremely long and are pervious, the septal ossification not extending between them.

The sternum has, at most, a mere rudiment of the manubrial process; and its posterior margin exhibits either four slight excavations, or two holes externally and two notches internally.

The proximal ends of the clavicles are greatly expanded and recurved; and their outer sides present a deep and wide excavation, at the bottom of which lies the pneumatic foramen. A great part of this excavated surface is left uncovered in front of the clavicular process of the coracoid when the bones are articulated together.

The scapular process of the coracoid is not prolonged forwards to meet the clavicles.

The posterior or ischio-iliac edge of the *os innominatum* presents a deep notch, which is not found in the other Aetomorphæ.

No lower larynx is developed.

The group of the *Gypaëtidæ* contains the Old World Vultures and the other "*Raptores diurnæ*," except *Gypogeranus*.

With the single exception of *Pandion* (according to Nitzsch) their contour feathers have aftershafts. The oil-gland is provided with a circlet of feathers.

The phalanges of the hallux, taken together, are much more than half as long as those of the fourth toe; and the articular surface of the metatarsal descends to the level of the other or nearly so.

The second and third phalanges of the fourth toe, taken together, may be longer or shorter than the basal; but the basal phalanx is always much longer than the second.

The basal phalanx of the third toe is longer than the second phalanx, which is sometimes (less commonly) longer, sometimes (more commonly) shorter than the penultimate phalanx.

The tarso-metatarsus is greatly flattened, and its inner edge thin and produced. On the upper part of its posterior face are two ridges (of which the inner is the more prominent) separated by a deep and wide groove.

There are no basipterygoid processes. The maxillo-palatines are more or less spongy; and narrow, or completely obliterate, the intervening valley.

The lachrymals commonly remain long distinct (especially in the Vultures).

The nasal apertures are usually little elongated, and are impervious by reason of the ossification of the septum.

The sternum has a more or less distinctly marked manubrial process. The posterior margin may be entire, and has not more than two holes or notches.

The proximal ends of the strong clavicles are expanded, recurved, and deeply excavated externally; but the large clavicular process of the coracoid fills the whole of the anterior moiety of this excavated surface when the bones are articulated. The scapular process of the coracoid sometimes is[*] and sometimes is not produced to the clavicle.

---

[*] *E. g.* in the Falcons proper and in *Polyborus*.

The inferior larynx is present, and has one pair of intrinsic muscles.

The division of the *Gypogeranidæ* consists of the single genus *Gypogeranus*, which, though allied to the Falcons in some respects, is so peculiar in others that it must be regarded as the type of a family apart. The feathers have an aftershaft, and the oil-gland a circlet (Nitzsch). The phalanges of the elevated hallux, taken together, are not more than half as long as those of the outer toe.

The basal phalanx of the fourth toe is much longer than the distal, and longer than the second and third together. These are subequal and very short, shorter than the fourth phalanx.

The basal phalanx of the third toe is much longer than the second, and the second is slightly longer than the third.

The shaft of the long tarso-metatarsal bone is prismatic, its antero-posterior diameter being as great as, or greater than, the transverse. The upper part of its posterior face presents a prominent process terminated by an expanded cordate surface, somewhat as in the *Cathartidæ*.

The skull has basipterygoid processes, and the spongy maxillo-palatines are completely united, so as to obliterate the intermediate valley. The lachrymal remains distinct; and the long external nares may be pervious, or not, according to the extent of the ossification of the septum. The sternum is escutcheon-shaped, and elongated. The posterior edge is convex, with two small emarginations on each side. There is a distinct manubrial process.

The proximal ends of the clavicles are not expanded, and are hardly excavated. A great median process extends from the symphysis of the clavicles, and becomes anchylosed with the sternum. The scapular process of the coracoid is not prolonged to meet the clavicle.

In the pelvis nothing is to be seen of that bending of the post-acetabular region of the ilium downwards and forwards, which is so strongly marked in most of the other Aetomorphæ.

6. The PSITTACOMORPHÆ.

The rostrum is arched and hooked at the extremity, and is regularly articulated with the frontal region of the skull.

Basipterygoid processes are wanting.

The palatines are vertically elongated posteriorly, while anteriorly they are horizontally flattened and moveably united with the rostrum. The maxillo-palatines are spongy. The lachrymal and the post-orbital bend towards one another and frequently unite below the orbit.

The orbital process of the quadrate bone is very small; and its distal end presents only one facet (which is compressed from side to side and convex from before backwards) for the mandible. The rami of the latter are deep, and pass into one another by a rounded truncated symphysis.

The sternum is not notched, but may present two foramina posteriorly.

The clavicles are relatively weak, and may be disunited, or absent. When present, they are concave forwards as well as inwards.

The tarso-metatarsus is very short in relation to the tibia, broad, and flattened from before backwards. Its outer distal articular head is divided by a groove into two articular facets.

The fourth toe, articulated with this double facet, is permanently turned backwards. The basal phalanges of the second, third, and fourth digits of the foot are shorter than the penultimate.

The inferior larynx has three pairs of muscles, and is, in other respects, peculiar.

The contour-feathers have a large aftershaft, and the oil-gland when present has a circlet.

The Parrots constitute one of the best-defined groups of birds, having affinities, though of no very close character, with the Aetomorphæ and the Coccygomorphæ.

+7. The COCCYGOMORPHÆ.

The rostrum presents very various forms, and may be moveably articulated with the skull. Basipterygoid processes are present only in one genus (*Trogon*).

The maxillo-palatines are usually more or less spongy. The palatines are not developed into vertical plates, but are, as usual, horizontally flattened.

The distal end of the quadrate bone has the ordinary form.

The sternum usually presents two notches on each side, and has no bifurcated manubrial process (ex. *Merops*).

The clavicles are convex forwards, and without any process developed backwards from the summit of their symphysis.

The tarso-metatarsus is never remarkably elongated.

It does not appear that anything can be predicated in common of the pterylosis or of the characters of the oil-gland in this group.

The larynx has not more than one, or at most two, pair of intrinsic muscles.

The Coccygomorphæ are readily divisible into four groups by the characters of their feet, as follows:—

a. *The first toe turned forwards, as well as the others.*

Coliidæ.

b. *The fourth toe temporarily, or permanently, turned backwards, as well as the first.*

Musophagidæ.
Cuculidæ.
Bucconidæ.
Rhamphastidæ.
Capitonidæ.
Galbulidæ.

c. *The second, third, and fourth toes turned forwards; the first backwards.*

Alcedinidæ.	*Meropidæ.*
Bucerotidæ.	*Momotidæ.*
Upupidæ.	*Coracidæ.*

d. *The first and second toes permanently turned backwards; the third and fourth forwards.*

Trogonidæ.

This group, as I have already intimated, appears to occupy the centre of the Desmognathous division—the *Musophagidæ* approaching the Aetomorphæ, the *Trogonidæ* the Cypselomorphæ, and the *Alcedinidæ* the Pelargomorphæ.

It appears to me not improbable that it may hereafter be desirable to divide this group into four, retaining the title of Coccygomorphæ for the second.

┼ The CELEOMORPHÆ.

The rostrum is straight and usually elongated, and there are no basipterygoid processes.

The maxillo-palatines are short lamellæ, which, when longest, do not extend beyond the outer edges of the palatines, and are sometimes altogether rudimentary.

The vomers are very delicate rod-like bones, which in some cases, at any rate, remain permanently separate.

The quadrate bone is remarkably short.

The sternum has two notches on each side, posteriorly, and a forked manubrial process. The carina extends to the summit of this process, its anterior edge being little (or not at all) excavated.

The clavicles have no median process; but their scapular ends are expanded, as in the typical passerine birds. The *scapula accessoria* has the same form as in the latter.

The upper and posterior process of the tarso-metatarsus is traversed by a number of canals (five in *Picus*) for the flexor tendons; and the outer distal head of the bone is divided into two parts, the fourth toe, which is articulated with it, being turned backwards.

In the second, third, and fourth toes the basal phalanx is shorter than the penultimate.

The tongue is long, slender, and protrusible; and there is only one carotid.

The oil-gland is surmounted by a circlet of feathers.

In this group I comprehend only the *Picidæ* and *Yungidæ*.

It is very difficult to assign the Celeomorphæ to their proper place. Ordinarily they are associated together with the Psittacomorphæ and Coccygomorphæ in the 'order' Scansores; but several ornithologists have pointed out the thoroughly unnatural character of this assemblage; and it is more than thirty years since

Sundevall[*] proposed to break it up into the three distinct groups of Pici, Psittaci, and Coccyges,—the first to contain *Picus* and *Yunx*; the last *Pogonias, Bucco, Crotophagus, Phœnicophæus, Coccyzus, Centropus, Cuculus, Galbula, Dacelo, Merops, Colaris, Trogon,* and *Caprimulgus*.

Sundevall calls these groups "orders;" but, leaving the question of taxonomic rank aside, the first two exactly correspond with the Celeomorphæ and Psittacomorphæ of the present essay; while the third nearly answers to my Coccygomorphæ,—a coincidence which I the more desire to signalize, as the Swedish naturalist attends only to external characters, while I have, almost exclusively, been guided by the skeleton.

Kessler[†] takes very much the same view as Sundevall, though he is inclined to put *Bucco* along with the Woodpeckers, instead of arranging it, as Sundevall more justly does, with the Cuckoos.

Not that the resemblances pointed out by Kessler do not exist; they are genuine enough, just as are others which might be pointed out between the Woodpeckers and the Hornbills and other Coccygomorphæ; but the structure of the skull affords a very definite and complete distinction between the latter and any of the Gecinomorphæ.

The Woodpeckers, in fact, are not Desmognathous, the palate in these birds exhibiting rather a degradation and simplification of the Ægithognathous structure. The vomers retain throughout life the condition which is transitory in the Coracomorphæ. With the latter the Celeomorphæ have in common the shortness of the wing-coverts, the conical *scapulæ accessoriæ*, the bifurcate manubrium of the sternum, the multiperforate backward process of the tarso-metatarsus, and the brevity of the basal phalanges of the toes as compared with the penultimate.

Thus I conceive that the Celeomorphæ are intermediate between the Coracomorphæ and the Coccygomorphæ, and that they may be best associated with the former as an aberrant group of the Ægithognathæ, tending towards the Coccygomorphæ as the Cypselomorphæ do in another way.

The other Ægithognathæ are divisible into two groups, the Cypselomorphæ and the Coracomorphæ.

The Cypselomorphæ, like the Gecinomorphæ, are annectent forms between the Coracomorphæ and the Coccygomorphæ.

The vomer is truncated at the anterior end, and the maxillopalatines slender and disposed nearly as in the typical Coracomorphæ (? *Trochilus*).

The sternum is broad and is devoid of a forked manubrium. Its posterior edge may be entire, or may have two excavations on each side.

The furcula has no backwardly directed median process, or only a rudiment of it; and the scapular end of each clavicle is not expanded and T-shaped.

---

[*] Ornithologiskt System af C. J. Sundevall, Kongl. Vetensk. Akad. Handlingar, 1835, p. 68.

[†] "Beiträge zur Naturgeschichte der Spechte," Bulletin de la Société Impériale des Naturalistes de Moscou, 1844, pp. 331–340.

The lower larynx has not more than one pair of intrinsic muscles.

This group contains three very distinct families—the *Trochilidæ*, the *Cypselidæ*, and the *Caprimulgidæ*.

The first two families have a length of the manus and a brevity of the humerus which is peculiar to themselves, being only approached by the Swallows, and in a less degree by the *Caprimulgidæ*. In both *Caprimulgus* and *Ægotheles* the manus is slightly longer than the ulna, and the latter considerably exceeds the humerus in length.

Both the Swifts and the Goatsuckers have a slight rudiment of a vertical process developed from the middle of the furcula. *Ægotheles* approaches the Swifts more nearly than *Caprimulgus* does in the form of its palatine bones, and in the absence of basipterygoid processes.

The *Cypselidæ* are very closely related to the Swallows among the Coracomorphæ, while the *Caprimulgidæ* come near *Trogon*, and more remotely approach *Podargus* and the Owls.

The CORACOMORPHÆ.

There are no basipterygoid processes.

The vomer, single in the adult, is truncated in front and deeply cleft behind*. The maxillo-palatines are sometimes slender and rod-like, sometimes broader, but are never concavo-convex lamellæ, or tumid and elongated as in most Schizognathæ. The postero-external angles of the palatines are always well marked, and are frequently produced backwards.

The sternum has a forked manubrium, a strong carina with an excavated anterior edge, long costal processes, and, except in one or two cases (*Pteroptochus* and *Scytalopus*), its posterior edge has a single notch on each side.

The clavicles have expanded T-shaped scapular ends, and send back a vertical process from their inferior junction (except in *Menura*).

There is a conical *scapula accessoria*.

The tarso-metatarsus has a tuberosity perforated by six distinct canals for the flexor tendons.

The pollex is strong and turned backwards.

The basal phalanges are not longer than the penultimate, but usually much shorter in the anterior toes.

The contour-feathers have a small aftershaft, and the oil-gland has no circlet of feathers.

There is only one carotid, the left.

The lower larynx presents every degree of complexity. It may be wholly tracheal, or, as is more commonly the case, partly tracheal and partly bronchial; it may be devoid of muscles, or may have six pairs, or may be enveloped in a muscular mass.

---

* Nitzsch (Art. Passerinæ, Ersch und Grüber's 'Encyclopædie,' 1840) was the first to indicate this and many other distinctive characters of this group.

This immense group of birds corresponds in great part with the PASSERES of Linnæus and Cuvier, and wholly with the VOLUCRES of Sundevall, who thus defines it:—

> *Alarum tectrices breves. Pollex validus solus retroversus. Ungues compressi.*
>
> *Alæ pennis cubiti magnis tectricibusque parvis instructæ; tectrices cubitales minorem quam dimidiam pennarum partem tegunt. Margo alæ plicatæ non a pennis cubiti obtegitur; prima enim earum ad ultimam remigum applicata manet. Digiti semper 4. Pollex crassior vel longior semper volumine major quam digitus internus. Unguis pollicis semper multo major quam laterales sed in quibusdam non major quam medius. Digitus externus toto articulo primo cum digito medio concretus. Phalanx digitorum penultima reliquis multo longior; basales (in digito externo et medio) breves. Cutis pedum firma, arcte applicata, antice scutata. Tarsus scutis 7 : mediis longioribus, 2 infimis brevissimis superioribus et inferioribus opposita vice obliquis*; raro plumatus, nunquam reticulatus. Interdum scuta omnia præter 2 infima in unum levissimum, suturis obsoletis confluunt (tarsi caligati,* Illiger). *Digiti scutis phalangum 1 seu 2 longis, juncturarum brevibus. Apparatus musicus laryngis his avibus peculiaris.*

The *Volucres* thus defined are divided into two "orders," as follows:—

Ordo I. PASSERES. *Rostrum crassius conicum capite brevius. Maxilla inferior marginibus validis inflexis convergentibus postice altioribus.*

Rostrum a cranio paullo deflexum exit sutura vix longiore quam dorso rostri. Hinc limes faciei rectus apparet, nec ut in sequentibus ad fauces longè retorsum angulatus. Maxilla inferior ad semina frangenda constructa, ut nuper descriptum qua conformatione in rostro hiante fauces deflexæ apparent. Lingua parva subcrassa plerumque caret margine membranaceo. Rictus mediocris. Pedes minores graciles.

Ordo II. OSCINES. *Rostrum varium marginibus maxillæ inferioris simplicibus nec inflexis.*

Ordo polymorphus et specierum ditissimus cujus descriptio generalis adhuc fere tantum negativa existit.

Now the "Passeres" of Sundevall have all, so far as I have examined them, that peculiar form of the palatine bones which I have described as characteristic of the Finches; while the "Oscines" have the typical Ægithognathous arrangement. And, thus far, cranial characters appear to bear out the classification of Sundevall, though I neither think that the groups have the value he assigns to them, nor that their names are happily selected. It is quite impossible, for example, to restrict a term so commonly used in a wide signification as *Passeres*, to the sense in which Sundevall employs it.

---

* Scuta in *Ptilonorhyncho,* paucis *Myotheris, Coracina* et *Chasmorhyncho* 9. In quibusdam inter longilingues majores 8 parallela, æqualia.

Müller divided the whole of the *Insessores*, according to the structure of the lower larynx*, into OSCINES or POLYMYODÆ (of which Sundevall's "Passeres" form one family—the *Fringillidæ*), having the lower larynx formed partly by the trachea and partly by the bronchi, and possessing five or six pairs of muscles attached to the ends of certain of the bronchial rings; TRACHEOPHONÆ, with the lower larynx formed exclusively by a modification of the lower part of the trachea; and PICARIÆ, with the larynx either partly tracheal and partly bronchial, or wholly bronchial and with not more than three pairs of muscles.

Under the head of Picariæ, however, Müller included the Cypselomorphæ, Coccygomorphæ, and Psittacomorphæ, as well as the two Ægithognathous families *Tyrannidæ* and *Ampelidæ*; and thus a group of "Picariæ" very different from that of Nitzsch was established.

Later authors, adopting Müller's term of Tracheophonæ, have unfortunately extended the group so named to include the *Tyrannidæ* and *Ampelidæ*, dividing the whole of the "Passeres" into CANORÆ and TRACHEOPHONÆ.

Burmeister, for example, proposes this arrangement in his excellent monograph on *Coracina scutata*, and speaks of that bird as one of the Tracheophonæ; whereas his account of its larynx shows that it is altogether dissimilar to the tracheal lower larynx of the *Myiotheridæ*, *Scytalopodidæ*, and *Anabatidæ*, in which alone that singular structure has been found. Müller would have put *Coracina* among his Picariæ.

If for "Picariæ" we substitute a name formed in a manner analogous to Polymyodæ, viz. OLIGOMYODÆ, the Ægithognathæ would be divisible according to their laryngeal structure into three groups; and it becomes an important question how far the three divisions thus formed are natural, or present other differences beside those of the larynx.

From this point of view, and regarded as primary subdivisions of the Coracomorphæ, it seems to me clear that they are not natural. Burmeister has described *Coracina*; I have examined *Cephalopterus*, *Tyrannus*, *Eurylaimus*, *Pteroptochus*, and *Chasmorhynchus*; and in no one of them does the structure of the skull differ so much from that of a typical polymyodian Coracomorph (*e. g.* one of the Corvidæ) as does that of the also polymyodian *Coccothraustes*. *Pipra* resembles the Finches.

The sternum in most of these genera has the same characters as, and presents no greater varieties than are met with in, the Polymyodæ. But among the Tracheophonæ the small group of *Scytalopodidæ*, as Müller originally stated, have two notches on each side of the sternum, standing alone among the Coracomorphæ in this particular*.

---

* Though he wavers in his estimate of the taxonomic value of these divisions. See his paper, "Ueber die bisher unbekannten typischen Verschiedenheiten, &c.," Abhand. d. Berl. Akad. 1846, p. 367.

So far as their osteology goes, the Polymyodæ, Oligomyodæ, and Tracheophonæ form one great group, in which the Finches and the Scytalopidæ alone are distinguishable from the rest by any very important characters.

But one genus, *Menura*, stands apart from all the other Coracomorphæ.

The vomer in this singular bird is broad and rounded off in front, and deeply cleft behind.

The maxillo-palatines are altogether obsolete, or at any rate unossified—a condition which I have not observed in any other Coracomorph.

The sternum has a well-developed and forked manubrium; but its posterior edge is strongly convex, and only exhibits a slight notch on each side. It is unlike the corresponding bone in any of the other Coracomorphæ, in all of which the posterior edge is straight.

The furcula has no median process, and its scapular ends are comparatively little expanded.

The tarso-metatarsus has the typical structure; and the penultimate phalanges are much longer than the basal ones in the anterior toes.

Thus, with my present information, I should be disposed to divide the Coracomorphæ into two primary groups—one containing *Menura*, and the other all the other genera which have yet been examined. How the latter is to be subdivided is a difficult question, upon the consideration of which I do not at present propose to enter.

In concluding this paper, I desire to offer my best thanks to my friends Dr. Günther, Mr. Parker, and Mr. O. Salvin for their kindness in supplying me with specimens, to the Museum Committee of the Royal College of Surgeons and to Dr. J. E. Gray of the British Museum for the opportunities of freely employing the collections under their charge which I have enjoyed, and especially to Dr. Sclater for many valuable suggestions upon points of nomenclature.

P.S. I find I have omitted to refer to a memoir by Kessler entitled "Osteologie der Vogelfüsse," published in the 'Bulletin de la Société Impériale des Naturalistes de Moscou' in 1841, which is full of valuable information and suggestions. This writer was the first to draw attention to the great systematic value of the tarso-metatarsus and to what I have spoken of as the ratio of length of the phalanges. Kessler's views are fully borne out by M. Alphonse Milne-Edwards in the introduction to his great work on Fossil Birds, now in course of publication.

---

* In a specimen of *Pteroptochus megapodius* from Chili, in the British Museum, the two notches extend for fully half the length of the sternum, and the middle and outer processes which bound them are very slender. There is a large bifurcated manubrium; and the costal process is long and pointed, being directed forwards and outwards.